II. PAPER PRESENTATION SESSIONS

1a: American Monsoon (Nov. 2, 3:15pm-5:15pm)

1b: East Asian Monsoon (Nov. 2, 3:15pm-5:15pm)

2a: Interannual Variations & Global Modeling (Nov. 3, 3:15pm-5:15pm)

2b: Regional Modeling and Phenomena (Nov. 3, 3:15pm-5:15pm)

3 : Invited Papers (Nov. 4, 10:45am-12:05pm)

4b: Asian Summer Monsoon (Nov. 5, 10:45am-12:05pm)

5b: Interdecadal and Long Term Variations (Nov. 5, 1:30pm-2:50pm)

6b: Diagnostic and Prediction (Nov. 5, 3:15pm-4:15pm)

Paper Poster Session (Tea Breaks)

INTERDECADAL VARIABILITY OF THE SUMMER MONSOON PRECIPITATION OVER SOUTHEASTERN SOUTH AMERICA

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Abstract

Southeastern South America precipitation undergoes significant interdecadal variability with several periods. The modes of this variability are disclosed by an empirical orthogonal function analysis using annual precipitation totals in the period 1949-2002, filtered to retain only decadal/interdecadal variability. The results show modes that have strong seasonality. Correlation of the PCs with non-filtered monthly precipitation averaged over the regions of highest components shows that the first mode has got strong contribution from summer rainfall, especially in regions where summer is the peak rainy season. The correlation between PCs and global SSTs indicates the main features of important global modes of SST interdecadal variability.

INTRASEASONAL VARIABILITY OF THE SUMMER MONSOON IN SOUTH AMERICA: CONTRIBUTION OF DIFFERENT TIME-SCALES AND INTERDECADAL MODULATION

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Abstract

The summer monsoon precipitation in Brazil and South America undergoes intraseasonal variability in several time-scales. Characterizing this variability is important for the summer monsoon season is the peak rainy season over most of South America. This study characterizes, through spectral density analysis of observed daily precipitation over Brazil and southern South America, the spatial distribution of significant oscillations in several intraseasonal time-scales (2-10, 10-20, 20-30, 30-70 days). Besides, the contribution to the intraseasonal variance of variability in each of these frequency bands is assessed. This analysis, done for different periods (1965 - 1998, 1965 - 1975 and 1975 - 1998), discloses interdecadal modulation in the intraseasonal variability. This is the first study of intraseasonal variability on a quasi-continental scale carried out with daily observed precipitation from more than 3000 stations. Previous analyses of intraseasonal variability of precipitation over South America in this spatial scale have been carried out using OLR data.

RELATIONSHIP BETWEEN THE OCCURRENCE OF SOUTH AMERICAN LOW LEVEL JET AND DAILY PRECIPITATION AND TEMPERATURE EXTREME EVENTS

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Abstract

Summer precipitation over northeastern Argentina is influenced, among other features, by the moisture transport. This could be from the tropical North Atlantic into the Amazon Basin and then towards the southern Brazil-Northern Argentina region or from the tropical South Atlantic both converging into the South American Low Level Jet (SALLJ). This circulation could also influence Maximum (MaxT) and Minimum (MinT) Temperatures in the affected region.

This study introduces climatology of daily precipitation and daily MaxT and MinT associated with SALLJ episodes, classified in Chaco LLJ, no Chaco LLJ and no LLJ, during the warm semester (September to February) in Argentina (northern of 40°S).

The daily quintiles of MaxT, MinT and rainfall for each month in a climatological period (1959-1998) were calculated. The daily quintiles of rainfall were calculated without considering the zero rainfall.

In general there are little intraseasonal differences, considering the temperatures probability patterns. During Chaco LLJ days, there is very low probability of having a cold extreme temperature over the North, and a high probability of having a cold extreme MaxT or MinT (1st quintile) over the central region. The opposite pattern occurs for high Temperatures (5th Quintile). The cases of NO LLJ are opposite to the Chaco LLJ and the cases of no Chaco LLJ are intermediate. MinT is stronger related to the occurrence of Chaco LLJ than MaxT, with probabilities less than 5% of having extremely cold temperatures and higher than 50% of having extremely warm temperatures if it is a Chaco LLJ day.

During the No Chaco LLJ, the monthly pattern of the conditional probabilities, taking into account only the rainy days, presents more intraseasonal variability than the temperatures. If there is a Chaco LLJ day, the probability patterns show a N-S or NW-SE gradient. In the northeastern region, low probability of having low rainfall amount or high probability of having high rainfall amount is associated. The opposite pattern occurs during the cases of No Chaco LLJ. Taking into account every day of the months, including the zeros, the probability of having No Rain is higher (greater than 80%) during No LLJ than during Chaco LLJ (lower than 50%).

RELATIONSHIP BETWEEN CROSS-EQUATORIAL FLOW AND SOUTH AMERICAN MONSOON PRECIPITATION

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Abstract

A reliable seasonal prediction of precipitation over South America relies upon an improved understanding of spatial and temporal variations of precipitation in this region. From our study of 15-yr ECMWF reanalysis data, we have found that changes in the low-level cross-equatorial flow over the western Amazon correlate well with the latitudinal shift of precipitation over the tropical and subtropical South America on submonthly, seasonal and interannual timescales. This cross-equatorial flow is thus identified as a monsoon index for the South American region (hereinafter the V index). Our analysis shows that when the V index is southerly, precipitation is mainly located to the north of the equator. When the V index is northerly, precipitation shifts towards the Amazon basin and the subtropics. The V index is predominately southerly in austral winter and northerly in summer. The onset (demise) of the Amazon rainy season is led by an increase in the frequency of the northerly (southerly) V index. Hence, the V index is a good indicator for precipitation change over tropical and subtropical South America. The V-index-related variation explains more than 50% of the seasonal and interannual variations of precipitation over South America.

The subtropical low-level jets (LLJs) to the east of the Andes also strongly influence the Amazon precipitation. The dynamics processes responsible for the LLJs are also examined. The results indicate that the northerly LLJs are largely maintained by strong zonal pressure gradients locally, which are caused by a zonal flow crossing the Andes and lee cyclogenesis. When the zonal flow is distorted by an anticyclonic circulation over the subtropical South Pacific, the northerly LLJs tend to reverse as observed. The dependence of the LLJs upon the upstream wind pattern provides an interpretation for the seasonal variation of the South American LLJs due to the seasonal changes of large-scale circulation patterns over the South Pacific. We introduced a method for up to 5-day forecasts of the LLJs based on NASA QuikSCAT ocean surface winds over South Pacific. A cross validation indicates a significant predictability of South American LLJs.

INTERANNUAL VARIABILITY OF THE SOUTH AMERICA MONSOON IN AN AGCM CLIMATE SIMULATION

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Abstract

Aspects of the Monsoon circulation over South America and its interannual variability are discussed based on results from a 50 years climate simulation using the CPTEC/COLA AGCM with T62L28 resolution. The climatological features associated with the differences of summer and winter circulation and precipitation are well simulated. Summer features at high and low levels are well identified as the Bolivia High, Atlantic Trough, SACZ, Subtropical Atlantic High, ITCZ position, which differ from other features in the winter. These systems show an interannual variability, being affected by tropical/extratropical interactions through teleconnections and intraseasonal variability. In ENSO years, there are changes in the monsoon circulation, as changes in the intensity of the Bolivia High and SACZ. In El Nino there is desintensification of the Bolivia High and SACZ. The low level summer flow changes to a pattern similar to winter flow, and there is intensification of flow to the east of Andes, resulting in frequent occurrences of the Low Level Jet. These changes have an influence on the precipitation patterns over tropical and extratropical South America. In La Nina years, the opposite occurs, and the monsoon summer features are enhanced. The monsoon circulation is also affected by intraseasonal variability, as Madden and Julian Oscillation (MJO) and Pacific South America Pattern (PSA). The MJO affects the convection in the South America tropical/subtropical region, reducing or increasing the activity of the SACZ. All these model simulation aspects are comparable to observed features in OLR, precipitation and reanalysis wind field.

THE INFLUENCE OF LAND SURFACE ON THE WET SEASON ONSET OVER THE AMAZONIA

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Abstract

The influence of Amazon ecosystems change on the large variation of wet season onset has been analyzed using the fifteen years of European Centre for Medium Range Weather Forecasts reanalysis (ERA). Our results suggested that the transition from dry to wet season in Southern Amazonia is initially driven by increases of surface latent heat flux. These fluxes rapidly reduce Convective Inhibition Energy (CINE) and increase Convective Available Potential Energy (CAPE), consequently providing favorable conditions for increased rainfall even before the large-scale circulation has changed. The increase of rainfall presumably initiates the reversal of the cross-equatorial flow, leading to large-scale net moisture convergence over Southern Amazonia. An analysis of early and late wet season onsets on an interannual scale shows that a longer dry season with lower rainfall reduces surface latent heat flux in the dry and earlier transition periods compared to that of a normal wet season onset. These conditions result in a higher CINE and a lower CAPE, causing a delay in the increase of local rainfall in the initiating phase of the transition and consequently in the wet season onset. Conversely, a wetter dry season leads to a higher surface latent heat flux and weaker CINE, providing a necessary condition for an earlier increase of local rainfall and an earlier wet season onset. Our results support the notion that if land use change in Amazonia reduces rainfall during dry and transition seasons, it could significantly delay the wet season onset and prolong the dry season (Nobre et al. 1991).

EL NIÑO/LA NIÑA AND THE ONSET OF THE SOUTH CHINA SEA MONSOON

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ABSTRACT

The onset of the South China Sea (SCS) monsoon is related closely to the El Niño/La Niña events. During the El Niño/La Niña episode, the onset of the SCS monsoon is later/earlier. Based on the NCEP/NCAR reanalysis monthly data from 1950 to 2002 and the NOAA Outgoing Longwave Radiation (OLR) monthly data from 1975 to 2002, the physical process through which the El Niño/La Niña affects the onset of the SCS monsoon is studied in the present presentation. It is founded that during the El Niño/La Niña episode, negative/positive sea surface temperature anomalies (SSTA) exist in the tropical western Pacific. Corresponding to the negative/positive SSTA, the convective activities are depressed/enhanced. Therefore, anomalous convective cooling/heating appears over the tropical western Pacific. Based on the Gill-Matsuno tropical atmospheric model, the Rossby wave response of the tropical atmosphere to this anomalous convective cooling/heating leads to an anticyclone/cyclone anomaly over the area around the SCS in the lower troposphere.

Usually the onset of the SCS monsoon is in May. One of the most important conditions for the onset of the SCS monsoon is that the Western Pacific Subtropical High (WPSH) withdraws eastward from the SCS area. If the onset period is within the El Niño/La Niña episode, the anticyclone/cyclone anomaly over the area around the SCS in the lower troposphere induced by the Rossby wave response to the anomalous convective cooling/heating is favorable/unfavorable for the maintaining of the WPSH over the SCS area. Therefore, the withdrawing of the WPSH from the SCS area during the El Niño/La Niña episode is later/earlier, which in turn leads to a later/earlier onset of the SCS monsoon.

END OF BAIU IN WESTERN JAPAN AND ITS RELATIONSHIP WITH TROPICAL CONVECTION

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Abstract

East Asian summer monsoon experiences drastic seasonal changes, especially in the beginning and end of the Baiu/Mei-yu season. It is also known that abrupt change of convective activity occurs over the western Pacific in late July, almost concurrent with the climatological end of Baiu/Mei-yu season. Here, the relationship between the withdrawal of Baiu in western Japan and tropical convection was investigated in each year.

First, the Baiu withdrawal date in each year is defined objectively by utilizing NOAA outgoing longwave radiation (OLR) data for the period (1979-2003). Then, the state of tropical convection accompanied with the end of Baiu season is examined. The changing patterns of tropical convection associated with the end of Baiu are not always similar in each year. Four categories are classified based on the region and/or state of the tropical convective activity when the end of Baiu is clearly identified between late June and early August. The years convection is enhanced in both near the Philippines and in the western Pacific regions (PW-type)，in either of the above region (PH-type and WNP-type), and in South China region (SC-type). Composite analyses of the atmospheric conditions are performed for these four types using NCEP/NCAR reanalysis data. As a result, different characteristics of the general circulation changes before and after Baiu withdrawal are clearly identified among each type. This result indicates complicated relationship between seasonal changes of East Asian summer monsoon and tropical convection. The role of tropical intraseasonal variations will be of importance for such different relationship.

THE EAST-ASIAN SUMMER MONSOON ACTIVITY AND NORTHWARD JUMP OF THE UPPER-AIR WESTERLY JET

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Abstract

It is studied by using NCEP/NCAR reanalysis data (1980-1999) that the relationship between the northward jumps of upper-air westerly jet (the UWJ) location and two important events of the East-Asian summer monsoon action – the onset of summer monsoon over the South China Sea and the Meiyu rainfall beginning in the Yangtze-Huai Rivers basin. The systematic analyses show that the UWJ has northward jump phenomenon for two times during the transforming process from winter to summer and they are closely related to summer monsoon actions. The northward jump of the UWJ in East Asia for first time (jet location from 25-28°N to the north of 30°N) occurred about on May 8 in average, it is early about 7 days than the onset date of the SCS summer monsoon (mean date is May 15). The northward jump of the UWJ in East Asia for second time (jet location from 32°N to the north of 35°N) occurred about on June 7 in average, it is early about 10 days than the Meiyu rainfall beginning date in the Yangtze-Huai Rivers basin and can be the forewarning of Meiyu rainfall beginning. This two-times northward jumps of the UWJ location in East Asia are related to two-times reverses of meridional temperature gradient at the upper-middle troposphere (500-200hPa). During the seasonal transforming since the continent was heated quickly, so that meridional temperature gradient at the upper-middle troposphere will be reversed in the 5°N-25°N latitudes in South Asia. Then through the geostrophic adjustment, the flow field adjusts to the pressure field (temperature field) and it will lead to the northward jump of the UWJ location. The analyses also show that the enhancement and northward moving of the subtropical jet in the Southern Hemispheric subtropics can also influence the first northward jumps of the UWJ location in East Asia some times.

FAULTINESS OF A SINGLE EAST ASIAN WINTER MONSOON INDEX

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Abstract

This paper reveals two predominant modes of the East Asian winter monsoon (EAWM) in terms of resolving a complex Hermit matrix made of 850 hPa anomalous wind fields. One mode is characterized by a predominant anomalous meridional wind pattern over East Asia and the western North Pacific, which is closely related to the intensity of the Siberian High. Another displays dominant zonal wind anomalies over the same area, and exhibits more closely relation to the South Oscillation and the equatorial eastern Pacific sea surface temperature (SST). Because the two predominant modes are independent from each other a single the EAWM index is incomplete for studies and predictions of the EAWM. The result indicates that the real part and imaginary part of the leading complex principal component obtained from the Hermit matrix can be as two new and independent the EAWM indices because they well characterize the EAWM variations. The leading mode of the EAWM is a linear combination of the two predominant modes. The Arctic Oscillation (AO) could not produce a direct effect on the EAWM.

***Key Words*:** East Asian Winter Monsoon, predominant mode, Siberian High, ENSO

VARIATIONS OF SUMMER MONSOON RAINFALL AROUND THE KOREAN PENINSULA AND CHARACTERISTICS OF OGASAWARA HIGH PRESSURE

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To ameliorate understanding of the characteristics of large-scale environments associated with summer monsoon precipitation around Korea, we have defined the strong and weak Changma years. There exist distinguished characteristics between strong and weak Changma years. Weak Changma is well correlated with weak Pacific High as seen in the changes in sea level pressure, 500hPa geopotential height, and wind speed in the lower level jet. Strong Changma might be associated with strong migratory highs in northern parts of the Korean peninsula. It is also shown that the behavioral changes in Ogasawara high-pressure system and north Pacific high are characterized with strong and weak Changma. Special attention will be given to assessment of the interaction between the north pacific high and Ogasawara high, the role of migratory high over the north of Korea in terms of the retreat of Changma season and the time shift of maximum rainfall periods in Korea.

RELATIONSHIP BETWEEN 10-25 DAY AND 30-60 DAY VARIATIONS OVER THE SOUTH CHINA SEA DURING NORTHERN SUMMER

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Abstract

The interannual variability (IAV) of the intraseasonal variation (ISV) over the South China Sea (SCS) from 1979 to present was investigated with a special focus on the relationship between 10-25 day and 30-60 day ISV, using the NCEP/NCAR reanalysis data, OLR, SST and precipitation data. The 10-25 (30-60) days ISV is relatively active when 30-60 (10-25) days ISV is suppressed during Jun, July and September. The IAV of ISV during the early summer (June-July) is related to IAV of SCS monsoon onset. The late (early) onset is accompanied by active 10-25 (30-60) day ISV. The strength of ISV activity in the early summer does not persist into latter summer (September). In other words, the IAV over the SCS can be divided into two periods: before and after August. It is also found that large-scale circulation anomalies associated with the IAV of ISV have different spatial structures during these two periods.

THE BOREAL-SUMMER INTRASEASONAL OSCILLATIONS SIMULATED IN A HYBRID COUPLED ATMOSPHERE-OCEAN MODEL

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Abstract

The boreal-summer intraseasonal oscillation (BSISO) simulated by an atmosphere-ocean coupled model is validated with the long-term observations. This validation focuses on the three-dimensional water vapor cycle associated with the BSISO and its interaction with underlying sea surface. The advantages of a coupled approach over stand-alone atmospheric approaches on the simulation of the BSISO are revealed through an inter-comparison between a coupled run and two atmosphere-only runs.

This coupled model produces a BSISO that mimics the one presented in the observations over the Asia-western Pacific region. The similarities with the observations include 1) the coherent spatio-temporal evolutions of rainfall, surface winds and SST associated with the BSISO; 2) the intensity and period (or speed) of the northward-propagating BSISO; and 3) the tropospheric moistening (or drying) and overturning circulations of the BSISO. However, the simulated tropospheric moisture fluctuations in the extreme phases (both wet and dry) are larger than those in the ECMWF analysis. The simulated sea surface cooling during the wet phase is weaker than the observed cooling. Better representations of the interaction between convection and boundary layer in the GCM and including salinity effects in the ocean model are expected to further improve the simulation of the BSISO.

The inter-comparison between a coupled run and two atmospheric runs suggests that the air-sea coupled system is the ultimate tool needed to realistically simulate the BSISO. Though the major characteristics of the BSISO are very likely determined by the internal atmospheric dynamics, the correct interaction between the internal dynamics and underlying sea surface can only be sustained by a coupled system. The atmosphere-only approach, when forced with high-frequency (e.g. daily) SST, introduces an erroneous boundary interference on the internal dynamics associated with the BSISO. The implications for the predictability of the BSISO are discussed.

INDIAN OCEAN SEA SURFACE TEMPERATURE AND THE MONSOON-EL NIÑO-SOUTHERN OSCILLATION SYSTEM: A NEW PERSPECTIVE

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Abstract

The monsoon-El Niño-Southern Oscillation phenomenon is one of the most prominent modes of interannual variations of worldwide climate. Thus, predicting its variability several months in advance is a major goal of climate research. Here we show that the 1976-1977 climate regime shift was accompanied by a remarkable change in the lead-lag relationships between Indian Ocean sea surface temperature and El Niño evolution. Southern Indian Ocean sea surface temperature in boreal winter is among the best precursors of El Niño development in the Pacific Ocean with a one year lead after the 1976-1977 climate regime shift. We also identify physical mechanisms which may be responsible of this surprisingly statistical relationship which emerges only during recent decades. These results shed some light on the possible influence of global warming or decadal fluctuations on El Niño evolution through changes in atmospheric teleconnection patterns between the Indian and Pacific Oceans. This suggests that Southern Indian Ocean sea surface temperature anomalies exert a fundamental influence on the transitions of the whole monsoon-El Niño-Southern system after the 1976-1977 climate shift.

IS THE TBO A COUPLED ATMOSPHERE-OCEAN MODE IN THE ASIAN-AUSTRALIAN MONSOON REGION?

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Abstract

In contrast to the clear spatial and temporal structures of the El Nino-Southern Oscillation, the structure and evolution characteristics of the tropospheric biennial oscillation (TBO) are unclear. Using an extended EOF technique, the authors illustrate the dominant pattern of the evolving TBO in the Asian-Australian monsoon region. It is noted that the most pronounced feature is the development of two anomalous anticyclone centers located in the southeast Indian Ocean (SIO) and western North Pacific (WNP), respectively.

The seasonal evolution of the two anomalous anticyclones is summarized as follows: From June to August of the first year of the TBO cycle, the low-level circulation anomalies are dominated by an elongated anticyclonic ridge extending from the maritime continent to India. Associated with this anticyclonic ridge is a tilted belt of pronounced anomalous westerlies extending from the Bay of Bengal to the WNP, suppressed convection over the maritime continent, and enhanced convection over the Philippine Sea. From September to November, the SIO anticyclone grows explosively, leading to a giant anticyclonic ridge that dominates the Indian Ocean and has its center at 10ºS, 90ºE. A weak anomalous low-level anticyclone forms in the South China Sea near the Philippines. From December to February, the low-level circulation anomalies are dominated by two subtropical anticyclonic systems located in the SIO and the WNP, respectively. The former is a result of the weakening of the fall SIO anticyclone, while the later results from the amplification and eastward migration of the Philippine anticyclone. The period from March to May has a similar anomaly pattern in the WNP, characterized by the pronounced WNP anomalous anticyclone. The intensity of the WNP anticyclone, however, decreases toward summer. From June to August of the second year in the TBO cycle, subsidence controls the region over the Philippine Sea and Southeast Asia, signifying a weakening of the summer monsoon over the WNP and South Asia. The anomaly circulation pattern is nearly opposite to the one in the previous summer.

To understand the origin of the TBO, numerical experiments with a hybrid coupled atmosphere-ocean GCM are conducted. The atmosphere and ocean are fully interactive in the tropical Indian Ocean and western Pacific (west of the date line), while the climatological SST is specified elsewhere. The results show that the atmosphere-ocean interaction in the warm oceans is essential to reproduce the temporal and spatial structures of the observed TBO. Further experiments with the inclusion of the eastern tropical Pacific but without the consideration of El Nino delayed oscillator dynamics (by simply eliminating the effect of thermocline depth anomalies on the SST) suggest that the biennial component of ENSO may result from the inter-basin teleconnection between the tropical Indian and Pacific Oceans.

ANTARCTIC OSCILLATION AND THE DUST WEATHER FREQUENCY IN NORTH CHINA

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Abstract

The linkage between the Antarctic Oscillation (AAO) to the dust weather frequency (DWF) in North China is addressed. Here DWF denotes the number of days of dust weather events including dust haze, blowing dust and dust storm in one year. It is found that the interannual variation of AAO plays a significant role in the dust-related atmospheric circulation during boreal spring. AAO and DWF correlate well, with positive AAO tending to decrease DWF in North China. Two possible mechanisms for the AAO-DWF coupling are identified, one is related to a meridional teleconnection pattern; the other is related to a regional circulation pattern over the Pacific Ocean.

Key words: Antarctic Oscillation, Dust weather frequency, Linkage, North China

RELATIONSHIP OF THE WINTERTIME STATIONARY PLANETARY WAVE ACTIVITY TO THE WINTER MONSOON OVER EAST ASIA

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Abstract

The landmass-ocean thermal contrast is generally considered fundamental to both the monsoon circulations and stationary planetary waves. In this paper, the authors have explored the relationship between the variablities of planetary wave activity and East Asian monsoon on the interanuual timescale. The composite differences between high and low index of planetary wave activity indicate that the equatorward propagation of planetary waves in the middle and upper troposphere tends to be stronger in association with weaker upward propagation into the stratosphere in a high wave activity winter than in a low index winter. The weakening upward propagation of wave activity implies a weaker perturbation to the polar vortex. Hence, the polar vortex tends to be cold and strong in a high wave activity index winter. The associations between planetary wave activity and monsoon circulations over East Asia indicate reduced East Asia jet, weakened East Asia trough, weakened Siberian High and Aleutian Low both. The weakened Siberian High and Aleutian Low may induce weaker northeasterlies along the east flank of the Siberian High. Thus, warming tends to appear in the continental parts of northeastern Asia. Further analysis presents that the zonal wavenumber 2 of planetary waves is dominantly contributed to the interannual variations of East Asian winter monsoon associated with the variability of planetary wave activity.

A GCM STUDY ON TROPICAL INTRASEASONAL OSCILLATION

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Abstract

The ability of atmospheric general circulation to simulate the tropical intraseasonal oscillation (ISO) (30-60 day) has been studied using the output of global spectral model (ALGCM (R42L9)) of the Institute of Atmospheric Physics, Chinese Academy of sciences, compared with the results from the Daily-mean reanalysis data from NCEP/NCAR for the year 1978-1989. The model displays an evidence periodic signal of intraseasonal oscillation in tropical area. The basic moving character of tropical ISO is captured, and the change in phase speed between eastern and western hemispheres is also well present, and the simulation of eastward propagating is better than that of the westward propagating, it is a better reproduction in winter and in spring than in summer and in autumn. Although most models underestimate the strength of the ISO, this model has increasing ability to simulate the strength of the tropical intraseasonal oscillation, especially a marked strong kinetic energy of ISO at 200hPa high. Horizontal structure of the wind of ISO is basically simulated by this model which convergence in low air and divergence in upper air. The vertical structure of the zonal wind is also well reproduced. Moreover observed results show that the representing of seasonal preference to form strong ISO in winter and in spring is related to ISO's interannual variability, but it is represented in this model with strong ISO in winter and in summer and weak ISO in spring and in autumn. The structure of some physical elements such as vertical velocity, vorticity, divergence and specific humidity and so on and the special distribution of ISO have also differences with these from NCEP reanalysis data, which make it clear to develop this model to simulate the structure and special distribution of ISO.

DEVELOPMENT OF INDIAN AND AFRICAN MONSOON IN THE COUPLED NAVY MODEL

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Abstract

Coupled Navy analysis and prediction system is used to analyze the development of Indian and African monsoon in 2002. We evaluate the performance of the system in predicting. We are particularly interested in the intraseasonal variability of the Indian and African monsoon and the interaction between monsoons, SST and convective systems in the Indian Ocean and Atlantic ITCZ.

The Navy Global Coupled System consists of tightly integrated global circulation models of the atmosphere (the Navy Operational Global Atmospheric and Prediction System) and the ocean (the Parallel Ocean Program), and atmospheric and oceanic data assimilation components. The NOGAPS version used in coupled model has T159 horizontal resolution and 30 layers in vertical. The ocean circulation model, POP, is a descendent of the GFDL Bryan-Cox-Semtner model family (Semtner, 1997) that was developed at Los Alamos National Laboratory (Smith, et al, 1992). In the coupled configuration POP is run on a ½o resolution Mercator grid with 36 vertical levels. The coupling or flux exchange between atmosphere and ocean occurs every 3 hours with POP supplying the sea-surface temperature to the atmosphere, and NOGAPS providing momentum, heat, and moisture fluxes directly to the ocean model.

The coupled model is initialized using the atmospheric fields from the NOGAPS analysis system and ocean fields from the Navy Coupled Ocean Data Assimilation system (NCODA).

A PARAMETERIZATION ALLOWING AEROSOL-CLOUD-CLIMATE INTERACTION IN SIMULATING THE EAST ASIAN SUMMER MONSOON

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Abstract

Recent studies indicate that the cloud radiative forcing (CRF) provides a significant heat sink in East Asian summer monsoon (EASM) and that the CRF exhibits strong interannual variation (Wang et al., 2004). The CRF is a macroscopic parameter revealing the total (solar and thermal) radiative effect associated with vertical distribution of cloud cover and cloud optical properties. The latter are sensitive to aerosols and their evolution into cloud droplets, and the issue becomes important because concerns have been raised abut the increased atmospheric aerosol loadings (sulfates, dust, etc.) over East Asia, not only for their direct effects on the radiative forcing, but also their indirect effect on cloud microphysics in which the aerosol-cloud particle interaction affects strongly the lifetime of cloud and certainly the precipitation process and EASM.

To consider interactive aerosol-cloud scheme in regional climate models requires the inclusion of the factors that control the cloud condensation nuclei which depends on the size distribution of water-soluble species (sulfates, organics, sea salt and nitrates), and the degree of solubility and the amount of mixing of individual species within a given size fraction. Although considerable progress is being made in recent years to include parameterization for aerosol-cloud droplet interaction and explicit microphysics for cloud water/ice content, inadequate understanding of the processes, in particular those affecting the cloud droplet number concentration, contribute significant uncertainties. The present study describes a comprehensive approach to parameterize the aerosol-cloud-climate interaction for simulating EASM. Preliminary results will be shown and discussed within the context of current parameterization used in the climate models.

Reference

Wang, W.-C., W.-S. Kau, C.-T. Chen, H.-H. Hsu, and C.-H. Tu, 2004: Characteristics of cloud radiative forcing over East Asia. *J. Climate*, East Asian Climate (EAC) Special Issue, **17**, 845-853.

REGIONAL CLIMATE MODELING OVER SOUTH AMERICA AND SOUTH ASIA

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Abstract

Regional climate over South America and South Asia is studied by using regional climate model RegCM.

Over South America, the interannual variation of regional climate is studied by multi-year simulations. The results indicate that the regional climate in the tropics is more subject to local SST forcing than that in the extratropics. In contrast, the climate in the extratropics is more sensitive to teleconnections through the lateral boundary forcing. The impacts of the initial states of both the atmospheric and soil variables, however, are relatively weak.

RegCM is also used to downscale regional climate over Sri Lanka and South India from the coarse-resolution GCM simulation by ECHAM4.5. Seven member ensemble simulations of ECHAM4.5 are used to drive RegCM with the grid-size of 100km, 50km, and 20km. It is found that the horizontal resolution of 20km-grid is needed to sufficiently represent the central mountain range of Sri Lanka and to reproduce the topographic precipitation, which is strongly dependent on the direction of the low-level monsoonal flow.

The variable-resolution stretched-grid method is also developed for the regional model to focus very high-resolution over a small area of interest and meanwhile use fairly large model domain. The stretched-grid RegCM is applied over South America, South Asia and Southeast Asia for regional climate downscaling.

STRUCTURE OF MOIST LAYER AND SOURCES OF WATER OVER THE SOUTHERN REGION FAR FROM THE MEIYU/BAIU FRONT

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Abstract

We investigate the structure of a moist layer and sources of water in the southern region far from the Meiyu/Baiu front using GAME (GEWEX Asian Monsoon Experiment, GEWEX: Global Energy and Water Cycle Experiment) reanalysis data. In the period from July 4 to 15, 1998, the Meiyu/Baiu front is located over northern China (the Yellow River Valley) and the Korean Peninsula. Both regions over the plain area of mainland China (the eastern region of 112 deg. line) and the East China Sea have very moist air masses in this period; their amount of total precipitable water is about 50 kg m^{-2}. However, the structure of these moist layers is quite different. The moist layer over mainland China is deep, reaching 600 hPa. On the other hand, the moist layer over the East China Sea is shallow, with a thickness of up to 800 hPa. This difference in the structure of the moist layers can be attributed to the development of a moist convective mixing layer and the generation of shallow convective clouds in the daytime over mainland China as a result of the supply of abundant latent and moderate sensible heat fluxes from the land surface.

We also examine sources of water supplied into the Meiyu front using Colored Moisture Analysis. Though water vapor to generate the deep moist layer over mainland China is mainly transported from the upstream regions of the Asian summer monsoon, which include the Indian Ocean, the Indochina Peninsula, and the South China Sea, the rate of the contribution of water from the southeastern region of mainland China is also over 15% of the total precipitable water, when the Meiyu front is located over northern China. It shows that the land surface over southeastern China is also regarded as a major source of water.

A STUDY ON THE THREE-DIMENSIONAL STRUCTURE OF WATER VAPOR TRANSPORTATION TO THE MEIYU RAINFALL IN 2003

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Abstract

The diagnostic analysis of water vapor transported to the Mid-lower reaches of Yangtze River Basin is carried out with the NCEP/NCAR reanalysis data. The result suggests that there exist three major water vapor channels in different levels and different thickness with different amount of moisture. Those water vapor channels play an important role to Meiyu rainfall. The numerical simulation with MM5V3 is performed to study the mechanism of the Meiyu rainfall associated with those water vapor transportation.

SEASONAL CLIMATE FORECASTS OF THE ASIAN MONSOON USING MULTIPLE COUPLED MODELS

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Abstract

Using as many as 67 different seasonal-forecast runs per season, from a variety of coupled (atmosphere-ocean) models, consensus seasonal forecasts have been prepared using about 4500 experiments. These include the European Center's coupled model DEMETER database and a suite of Florida State University coupled atmosphere ocean models. This is one of the largest databases on coupled models. The monsoon region was selected to examine the predictability issue. The methodology involves: (i) Construction of seasonal anomalies of all model forecasts for a number of variables, such as, precipitation, 850 hPa winds and 2-meter/surface temperatures and Sea Surface Temperatures, (ii) Exploring skills of ensemble mean, (iii) Exploring skills of FSU multimodel superensemble, where we use a new synthetic database to enhance the skills called the synthetic superensemble. The metrics for forecast evaluation include: computation of hindcast and verification anomalies from model/observed climatology, time-series of specific climate indices, standard deterministic ensemble mean scores such as anomaly correlation coefficient and root mean square error. The results were deliberately prepared to match the metrics used by European DEMETER models, Palmer et al., (2004). Invariably in all modes of evaluation the results from the FSU multi model superensemble demonstrate greater skill, for most of the variables tested here, than those obtained in earlier studies. Our specific enquiry was on this question: is it going to be wetter or drier, warmer or colder than the long-term recent climatology of the monsoon, and where and when during the next season? These results are most encouraging; suggesting that this vast database and our methodology are able to provide some useful answers to the seasonal monsoon forecast issue compared to the use of single climate models or from the conventional ensemble averaging.

ONSET AND SEASONAL EVOLUTION OF THE ASIAN SUMMER MONSOON IN 1991 AS SIMULATED BY AN AGCM

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Abstract

CCSR/NIES/FRCGC joint modeling group made 20 years global simulation for 1979-1998 by an AGCM (primitive equation spectral model T106L56; the triangular spectral truncation at-wave-number 106 with 56 layers) with inter-annually varying observed sea surface temperature.

This study presents the features of the onset and seasonal evolution of Asian summer monsoon simulated for 1991, in comparison with observational studies for this year.

The onset of the Indian monsoon is reasonably reproduced by the model. The abrupt intensification of the Indian monsoon westerly associated with intensification of Somalia low-level jet stream is well simulated by this model. The Indian monsoon westerlies are sustained until the end of September. The quasi-periodic intraseasonal variation of the Indian monsoon westerlies with 20-day period appeared during this period. While the precipitations around the Bay of Bengal and the Indo-China Peninsula are reasonably reproduced, the precipitation over the western coast of India is considerably underestimated.

The precipitation around the South China Sea began to increase in the middle of May in association with the increase of the southerly wind. Simultaneously, an east-west oriented precipitation zone, which corresponds to the Meiyu-Baiu precipitation zone, is formed along 30N latitude circle. The Meiyu-Baiu precipitation increased in association with the onset of the Indian monsoon. The actual peak of 1991 Meiyu-Baiu precipitation occurred during 1-10 July, the simulated peak occurred in the end of June. The Meiyu-Baiu frontal precipitation weakened as it shifted northward to 40N around the early July.

The variation of the moisture sink/source and the vertical stability in the lower troposphere in the Asian summer monsoon region are compared with the observations.

INTERDECADAL VARIABILITY OF THE EAST ASIAN SUMMER MONSOON AND ITS ASSOCIATION WITH THE INTERDECADAL VARIATIONS OF THE WALKER CIRCULATION OVER THE TROPICS

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Abstract

In this paper, interdecadal variability of the Walker circulation over the tropics and its impact on the interdecadal variations of the EASM are analyzed by using the NCEP/NCAR reanalysis data and the ERA-40 data, respectively. It may be clearly shown from the analyzed results that influenced by the interdecadal variability of the SSTs in the tropical Pacific, the interdecadal variations of the Walker circulation are obvious, which have a large impact on the EASM and the summer monsoon rainfall in China, especially in North China. Due to the obvious warming of the tropical eastern Pacific from the late 1970s, the Walker circulation became weak over the tropical Pacific, which caused the weakening of the trade winds over the tropical western Pacific and the EASM. The weakening of the EASM led to the occurrence of the persistent droughts in North China.

The warming of the tropical eastern Pacific from the late 1970s also caused the anomalies of the Walker circulation over the tropical Atlantic and North Africa. An ascending anomaly-flow and a descending anomaly-flow were obviously located over the tropical eastern Pacific and North Africa, respectively. The intensification of the descending flow over the Sahel region of North Africa led to a strong anticyclonic distribution of circulation anomalies over the Sahel region of North Africa. The strong anticyclonic distribution of circulation anomalies over the Sahel region might influence the formation of the anticyclonic distribution of circulation anomalies over North China and Northwest China through the inducing a Rossby wave-train to the northeast, i.e., it caused a teleconnection pattern of circulation anomalies from the Sahel region of North Africa to North China and Northwest China through the propagation of quasi-stationary planetary waves. Furthermore, this anticyclonic distribution of circulation anomalies over North China and Northwest China is not helpful for the northward progress of the southerly wind to North China and monsoon rainfall in this region. Therefore, the intensification of the anticyclonic circulation anomalies over the Sahel region of North Africa may have an impact on the Asian summer monsoon over North China through the Rossby wave-train to the northeast.

As shown by Rodwell and Hoskins (1996), diabatic heating by the Asian summer monsoon can play a significant effect on the desertification of the Sahel region through the inducing a Rossby wave-train to the west. However, as shown by this study, the intensification of the anticyclonic circulation anomalies over the Sahel region also can influence the Asian summer monsoon over North China through the propagation of quasi-stationary planetary waves. Therefore, it is also possible that the desertification of the Sahel region may have an influence on the Asian summer monsoon over North China in interdecadal time-scale. This should be studied further by modeling.

OCEANIC INFLUENCE ON CONTINENTAL RAINFALL THROUGH MONSOON AS OBSERVED FROM SPACE

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Abstract

Monsoon, by its Chinese definition, is the seasonal change of winds. The change is caused by the reversal of land-ocean temperature gradient. The change of oceanic influence is manifested through continental rain. The Tropical Rain Measuring Mission (TRMM) is designed primarily to measure rain. A method has also been developed and validated to estimate the vertically integrated moisture transport (Q) in the atmosphere over the ocean using both spaceborne scatterometers and microwave radiometers. For major land masses over the world under the influence of monsoons, Q normal to the coastlines have been computed and compared with continental rainfall measured by TRMM for four years, starting 1999.

During the summer monsoon, from May to November, moisture is observed to be transported from the Arabian Sea across the west coast of the Indian subcontinent, and out to the Bay of Bengal across the east coast. The temporal variation of the net Q agrees and is in phase with the changes of rainfall integrated over the subcontinent. However, the onset of moisture moving out the subcontinent into the Bay of Bengal is earlier than the onset of moisture transport into the subcontinent from the Arabian Sea. There was a delay of the onset in 2002 which is related to the pattern of variations in other part of the oceans. The variation of rainfall over China and Indochina agrees very well and is in phase with the total transport from the Bay of Bengal and Indian Ocean but out-of-phase with moisture advection from the Pacific coastline. The variation of rainfall in South America is dominated by and is in phase with Q from the Atlantic, rather than that from the Pacific.

ZONAL PROPAGATION OF KINETIC ENERGY AND CONVECTION IN THE SOUTH CHINA SEA AND INDIAN MONSOON REGIONS IN BOREAL SUMMER

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Abstract

Zonal propagation of kinetic energy (KE) and convection in the South China Sea (SCS) and Indian summer monsoon areas are examined in present study. Results suggest that the SCS and Indian summer monsoon prevailed regions (5-15°N) are dominated by the southwesterly wind, however, the disturbances of KE at 850 hPa and convection are observed mainly coming from the western Pacific Ocean (140-150°E), after passing through the SCS, and westward propagated into the Bay of Bengal (90-100°E). In the Indian summer monsoon domain, where the disturbances of KE are found mainly coming from the Arabian Sea (AS) and eastward propagated into the Bay of Bengal. Therefore, the SCS and the Indian summer monsoon are quite different in zonal propagation of KE and convection. The SCS summer monsoon is mainly affected by the KE and convection coming from the tropical western Pacific. The Indian summer monsoon, however, can be partly influenced by the AS and the SCS summer monsoon. The analysis also suggests that the interaction region between the SCS and the Indian summer monsoon is around 90-95°E, rather than 105°E as proposed by earlier studies.

THE DIAGNOSTIC CRITERIA FOR ONSET/WITHDRAWAL OF ASIAN SUMMER MONSOON

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Abstract

The temporal and spatial structures of the atmospheric circulation associated with the climatology and inter-annual variations of the onset and withdrawal of Asian summer monsoon is studied using the ECMWF RA 40 reanalysis from 1957 to 2001. There by diagnostic criteria that retrospectively assesses the onset and withdrawal dates of the Indian monsoon and East Asian Monsoon are tested from variability in the large-scale hydrologic cycle and prevailing winds. To diagnose the onset date integrated moisture transport (VIMT) is used and for withdrawal a new circulation circulation withdrawal Index (CWI) is defined. This method offers several advantages as both the criteria are based on fields that are better modeled and measured than rainfall. These diagnostic criteria can retrospectively assess onset and withdrawal from re-analysis products and can be useful for studying climatological variability.

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THE FEATURES OF MOISTURE TRANSPORTATION IN SEASONAL TRANSITION OVER ASIAN-AUSTRALIAN MONSOON REGIONS

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Abstract

Basted on the integrated moisture transportation (MT) flux (from ground level to 300hPa) calculated by NCAR\NCEP reanalyzed daily data from 1980 to 1997, an investigation is carried out of the climatic annual cycle characteristics of MT over Asian-Australian Monsoon regions. The features of northward march and westward progression of the summer monsoon MT over East Asian are also discussed. Major results are as follows:

1. In winter (January), there are four almost latitudinal MT belts (channel) over Asian-Australian Monsoon regions. The strongest is the easterly MT belt over the low latitudes （5°N－10°N）in Asian, the second is the westerly MT belt over the region between 25°N and 30°N； Between them is a very weak MT belt corresponding to the subtropical high at low levels .There is still a moderately strong easterly MT belt over the Indian ocean in Southern Hemisphere；a westerly MT belt exists over 5°S－10°S, and it obviously becomes weak near the longitude of Sumatra island, where the high value belt shows a break. The two strong westerly MT belts over the north Australian and over the Indian Ocean, clearly originate from the cross equatorial MT in lower latitudes of Northern Hemisphere. The former is Australian summer monsoon and the later can be called Indian Ocean summer monsoon.

2. In summer (July), the obviously feature is that the strong easterly MT near 10°S cross the equator near 45°E forming the strongest southwesterly MT；It passes Arabian Sea, the Bay of Bengal, the indo-China peninsula, the Eastern China, Korea and Japan, at last flows into the north Pacific, like a big river. In addition, the cross equatorial MT near 105°E, the southeasterly MT from low latitudes of the middle Pacific and the weak westerly MT near 45°N all flow into the river.

3. The change of transportation pattern from winter to summer firstly takes place near 105°E in March. The southward cross equatorial MT disappears, Australian summer monsoon weakens obviously, and the westerly MT enhances near 25°N in Northern Hemisphere. In April the transportation by Australian summer monsoon disappears. The summer transportation pattern establishes in May. The earliest features of transportation pattern from summer to winter are the weakness of the northward cross equatorial MT from Southern Hemisphere in September, and they almost disappear in October, which is earlier in the east than in the west. At the same time, the easterly MT over the lower latitude of the west pacific progresses westward.

4. The northward march of the southerly MT with the summer monsoon over the East Asian shows the feature of staged jumping. Each jumping is related to the large-scale important weather incident in China. The southerly water vapor can progress to 50°N near North-East in China；the southeasterly(someone call it as southeast monsoon) water vapor from south side of the west pacific subtropical high can march westward to 100°E near south-east part of GanSu in summer ,where can be regarded as the westernmost position of the southeast monsoon.

CLIMATOLOGICAL MONSOON BREAK OVER SOUTHEAST ASIA IN NORTHERN SUMMER

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Abstract

Climatological monsoon break (CMB) over Southeast Asia was investigated using pentad rainfall data in Thailand and NCEP/NCAR reanalysis for 50 years (1951 to 2000). In this study, the terminology of CMB was defined by climatological monsoon break over the Indochina Peninsula. CMB has tendency to occur in late-June, which means nearly phase-locked to seasonal cycle. It was found that 80% of years are less than rainy seasonal averaged rainfall (6.7mm/day) during CMB, which shows that CMB is significantly different from monsoon breaks over India.

A result of atmospheric circulation associated with CMB shows that the southerly wind components are weaker than rainy onset phase or the first rainy peak period, which indicates northerly wind anomaly is important for reducing rainfall over the Indochina Peninsula.

The northerly winds are caused by an anti-cyclonic circulation anomaly over the Bay of Bengal.

IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES IN CHINA

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1. Introduction

In order to assess the impacts of climate change on water resources in China, some dynamic hydrology models have been coupled or nested with GCMs and regional climate models. The hydrology models nested with GCMs provide the general situations about climatic and hydrologic change in the whole country, while the ones coupled or nested with regional climate models simulate specific climatic and hydrologic change in basin scale. In North China, a distributed hydrology model DHSVM is developed to nest with regional climate models, and the Luan River and Sanggan River basins are chosen for both atmospheric and hydrologic modeling and analyzing.

2. Regional Impacts of Climate Change on Water Resources in China in Last 50 Years

Affected by both natural variability and anthropogenic activities, climatic conditions in China have obviously changed for last 50 years. Temperature in northern part rose about 1.0～2.5°C, while in southern and southwestern parts decreased somewhat in 1960's and 1970's.Precipitation was relatively abundant in 1950's, but reduced afterwards until 1990's. Climate change has undeniable impacts on water resources in China. In last 50 years, besides Pearl River and Songhua River, stream flow in most main basins such as Yangtze River, Huai River, Yellow River, Hai River and Liao River abated in different rates. The decreasing rate in Hai River is as high as 22.5～23.4 percent.

3. Climatic and Hydrologic Change in China in Future

According to the simulated results of coupled climate-hydrology model system, by the year 2030, temperature in China will increase 1.4～3.1°C in various regions, and precipitation change from minus 7.1 percent to positive 12.9 percent. Precipitation in the regions south to Yellow River seems to augment in certain degrees, but in some northern parts increase just slightly, while in the Northwest decrease about 7.1 percent. At that time, runoff in main river basins will increase except Yellow River and continental rivers in the Northwest. Runoff in the two regions will decrease 12.6～20.9 and 22.0 ～48.3 percent, respectively. Runoff in future for Luan He Basin and Sanggan He Basin is 74mm and 71mm, respectively, which is approximately a quarter of currently mean annual runoff (284mm) of the whole country. Total streamflow for the two basins will decrease about 2.5×108 m^3 in future. All that indicates the warm and dry trend will continue in North China in future. For the whole country, by the year 2030, water demand will exceed 1×1012m^3, which is 0.3259×1012m^3 more than in 1990's and near the most available amount 1.2×1012m^3.

4. Conclusion

Under global warming background, climate and water cycle in China have been obviously changing with regional differences for last 50 years. The warm trend will continue in future and alter precipitation distribution from region to region. In terms of simulated results, climate change will cause water shortage in some basins such as Hai River and Yellow River. The shortage amount for the two basins might be as high as 25.2 ×108 and 13.5 ×108m^3, respectively, which will obstruct sustainable development in the regions. In order to adapt and mitigate impacts of climate change on water resources in China, some specific strategies such as water saving, industry structure change, rational water allocation and water contamination disposal have been adopted, and the programs of water transfer from the south to the north have been implementing.

THE CHARACTERISTICS OF INTERDECADAL VARIABILITY OF EAST ASIAN SUMMER MONSOON

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Abstract

The East Asian Summer Monsoon is closely related to the severe flood and drought events in the region, and is distinct from the Indian Monsoon. The interdecadal variations of the East Asian Summer Monsoon and precipitations are studied using different data from CMA, Met. Office U.K. and NCEP for 1900-2000.

It is shown that there are two cycles of East Asian Summer Monsoon in last century. The variations of the second cycle of East Asian Summer Monsoon in last century are carefully studied. It is pointed that the stronger period of East Asian Summer Monsoon are from 1952 to 1966, the weaker from 1977 to 2000. It seems that the period of 1967-1977 is transition period. The geopotential height and sea level pressure anomaly patterns during summer season change sign from 1951-1961 to 1977-2000. The SST anomaly patterns in east tropical Pacific also change sign from stronger to weaker period. Further analysis shows that the relationship between East Asian Summer Monsoon and SSTs in east tropical Pacific are changeable. There are interdecadal variations of the relation between the summer precipitation over East Part of China and the East Tropical Pacific SSTs.

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THE CHARACTERISTICS OF MERIDIONAL WIND OVER SOUTH CHINA SEA AND ITS AFFECTING FACTORS ON INTERDECADAL TIME SCALES

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Abstract

The characteristics of meridional wind and its affecting factors over South China Sea on interdecadal time scales are analyzed by using the NCEP reanalysis data. The results show that, the meridional wind undergoes interdecadal change from strong to weak periods and is one of main factors that result in weakness of South China Sea summer monsoon. The reasons can be attributed to two aspects, one is the weakness of meridional temperature grads between sea and land, another is due to the interdecadal adjustment of sea level pressure over tropical Indian Ocean areas, the exchanges of latent heat and sensible heat between the ocean and the atmosphere over South China Sea areas are reduced, causing the SST unusually warming, leading to cyclone circulation, and resulting in the weakness of south wind direction.

INTERDECADAL INTENSITY INDEX OF ASIAN-AFRICAN SUMMER MONSOON

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Abstract

As a whole, Asian-African Summer monsoon changes synchronously on decadal and interdecadal time scales. According to monsoon being driven by the thermal difference between sea and land, this paper defines a interdecadal intensity index of Asian-African summer monsoon. The details are following:

The Asian-African summer monsoon is treated as a whole one on interdecadal time scale.

We average summer sea surface temperature above the Indian sea region (50°-90°E, 32.5°S-7.5°N), which stands for the key area around the Indian Ocean. Then we average summer land surface temperature above Asian continent (22.5°-37.5°N, 80°-120°E)and European continent respectively to represent the values of temperature above whole Eurasia continent s. At last we minus the later by the former and obtain the differences series as the index values of Asian-African summer monsoon intensity on long-range time scales, which is normalized and indicated by IAA. That is

$IAA=Nor\{T_o-T_l\}$

T_o: sea temperature anomalies normalized above Indian Ocean;

T_l: land temperature anomalies normalized above Eurasia lands.

When IAA is in high phase, the Asian-African summer monsoon system is weak; otherwise it's strong when IAA is in low phase.

IAA implies the mechanism that monsoon is driven by thermal difference between sea and land. In summer, land is warm and sea is relatively cool, thus temperature over Eurasia lands is higher than that over the Indian sea. The north is warmer than the south, so generated thermal gradients are from south to north. Over north African and Asian lands local low is formed, which leads warm and moist currents from southern seas flowing northward to generate monsoon. Usually, more larger the thermal difference , more significant Asian-African summer monsoon, and IAA in more lower phase, and vice versa.

This index can indicate significantly Asian-African summer monsoon intensity's decadal and interdecadal changes, and be out of phase with summer precipitation of arid and semi-arid transition areas in Asia and Africa on interdecadal time scales. When IAA is in low phase, Asian-African summer monsoon system is strong, and there is a rain-rich belt over arid and semi-arid areas from Japan, through North China and Northwest India to Sahel in northern Africa, and monsoon lows over Asian-African continents are intensified. It is opposite when IAA is in high phase. Comparing with stronger summer monsoon, weaker monsoon appears anomalous convergence in high atmosphere over Asian-African monsoon regions, which are not available for convective convergent ascending air in low atmosphere, and therefore the Asian-African summer monsoon system is weak.

A DIAGNOSTIC STUDY OF RECORD HEAVY RAIN IN TWIN CITIES ISLAMABAD-RAWALPINDI

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Abstract

Using surface and NCEP reanalysis data along with radar and satellite images, diagnosis has been carried out to probe the reasons of the very heavy rainfall of 620mm in only 10 hours that occurred in Islamabad-Rawalpindi (Pakistan) on 23 July 2001. It has been revealed that the sudden evolution of this meso-scale severe weather system was the direct result of strong surface convection in moist and unstable lower layers of the atmosphere. The subsequent rapid development was the combined effect of presence of mid latitude westerly's trough in the north and moisture feeding through monsoon flow along the Himalayas and also the direct southwesterly current from the Arabian Sea. After westward shifting of western portion of Sub-Tropical High (STH) from north of India, the strong convergence zone in its eastern edge would have contributed positively for development of upward motion. Initially the convective systems moved towards south and then southeastward following the steering current in the middle troposphere. Based on these analyses, the physical model of the sudden record heavy rainfall has been proposed and comparison between the heavy rainfall in this case and that in China during July 1998 has been conducted.

MONSOON VARIABILITY AND PREDICTABILITY OVER SOUTH AND EAST ASIA

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Abstract

The author has done considerable work on the summer monsoon rainfall variability and predictability over South Asia (India, Bangladesh, Nepal), East Asia (China, Korea, Japan) and Southeast Asia (Myanmar, Thailand, Malaysia, Vietnam, Indonesia, Philippines) in collaboration with scientists in India, Korea and China. Extensive data sets have been used for periods varying from 1870 to 2000. The variability, predictability and their tele-connections have been examined in relation to the El Nino Southern Oscillation, Eurasian snow cover, Global Warming and the recently identified Indian Ocean Dipole Mode.

All these studies have shown that with the analysis of available instrumental historical rainfall and other data sets, some valuable scientific insight can be gained on the Asian monsoons on inter-annual and decadal time scales:

- Impact of ENSO events on summer monsoon rainfall is modulated by the decadal behavior of rainfall i.e. impact of El Nino (La Nina) is more severe during the below (above) normal epochs. Thus impact depends on the prevailing epoch (Kripalani and Kulkarni 1997 a, b ; 1998; Kripalani et al 2001, 2003)

- Wintertime snow depth over western (eastern) Eurasia is negatively (positively) related with subsequent monsoon rainfall over South and East Asia. This dipole correlation configuration is indicative of a long-wave mid-latitude circulation pattern which affects the monsoon flow over South and East Asia and the North Pacific Subtropical High over East Asia (Kripalani and Kulkarni 1999, Kripalani et al 2001, 2002a)

- The relationship of the Indian Ocean Dipole Mode with monsoon variability appears to be stronger over East Asia, in particular over the Korean-Japan sector than over South Asia (Kripalani et al 2004)

- The monsoon variability over South and East Asia is connected either via the northern hemisphere mid-latitudes or via the south Indian Ocean / West Pacific route (Kim et al 2002b ; Kripalani and Kulkarni 2001; Kripalani et al 1997, 2004)

These could serve as a guiding tool for extended and long range forecasting. It is proposed to interact with leading scientists in this area by presenting the summary and reviewing the main results of these studies at the Third International Workshop on Monsoons (IWM-III) to be held in Hangzhou, China during November 2004.

References

Kripalani, R.H., J. H. Oh, JH Kang, SS Sabade, A Kulkarni 2004: Extreme monsoons over South and East Asia: Possible role of Indian Ocean Dipole Mode. Theoretical and Applied Climatology (submitted)

Kripalani, R.H., A Kulkarni, SS Sabade, ML Khandekar 2003: Indian monsoon variability in a Global Warming Scenario. Natural Hazards 29, 189-206.

Kripalani, R.H., B.J. Kim, JH Oh, SE Moon 2002a: Relationship between Soviet snow and Korean rainfall. International Journal of Climatology 22, 1313-1325.

Kim, B.J., S.E. Moon, Riyu Lu, RH Kripalani 2002b: Tele-connections: Summer monsoon over Korea and India. Advances in Atmospheric Sciences 19, 665-676.

Kripalani, R.H., A Kulkarni 2001: Monsoon rainfall variations and tele-connections over South and East Asia. International Journal of Climatology 21, 603-616

Kripalani, R.H., A Kulkarni, SS Sabade 2001: El Nino Southern Oscillation, Eurasian snow cover and Indian monsoon rainfall. Proceedings Indian National Science Academy, 67A, 361-368

Kripalani, R.H., A Kulkarni 1999: Climatology and variability of historical Soviet snow depth data: some new perspectives in snow-Indian monsoon tele-connections. Climate Dynamics 15, 475-489

Kripalani, R.H., A Kulkarni 1998: The relationship between some large-scale atmospheric parameters and rainfall over Southeast Asia: A comparison with features over India. Theoretical and Applied Climatology 59, 1-11.

Kripalani, R.H., A Kulkarni 1997a: Rainfall variability over Southeast Asia-Connections with Indian Monsoon and ENSO Extremes: New perspectives. International Journal of Climatology 17, 1155-1168

Kripalani, R.H., A Kulkarni 1997b: Climatic impact of El Nino / La Nina on the Indian monsoon: A new perspective. Weather 52, 39-46

Kripalani, R.H., A Kulkarni, SV Singh 1997: Association of the Indian summer monsoon with the northern hemisphere mid-latitude circulation. International Journal of Climatology 17, 1055-1067.

EFFECT OF RECENT IMPROVEMENTS IN A MESOSCALE MM5 MODEL ON THE PREDICTION OF MONSOON SYSTEMS OVER THE INDIAN REGION

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Abstract

The MM5 mesoscale model version 3.4 (MM5 v3.4) had been running in real-time mode at NCMRWF since 1st January 2002. The model was configured at triple nested domains at 90, 30 and 10 Km resolutions. The model is run using the boundary conditions from the T80 global model of NCMRWF. The model has been very successful in producing severe weather forecasts up to 72 hours over the Indian region. During the last two years, several improvements, bug fixes, and modifications have taken place in the model.

In view of the recent improvements of the model and based on new demands from several user agencies, the model was recently upgraded from v3.4 to v3.6. Among several improvements, the new version allows for cloud field in the initial conditions while there is no cloud/rain in the boundary conditions (e.g. forecast cycling of cloud water). It also allows the MRF PBL to make the soil temperatures more robust in some rare condition. In the new version two new inner domains at 10 Km resolution have been set up; one over central Himalayas to cater the needs of Mount Everest expeditions and another domain over the West Bengal and adjoining areas to fulfill the needs of a national STORM project of India. Before implementing the new version of the model, the two versions were run on parallel mode for about one month during 17th April to 15th May 2004. The present paper provides a comparative analysis of simulation of different weather systems over the monsoon regime. One of the cases was a western disturbance that affected the north India on 30th April 2004 and, another case was a cyclonic storm of the Arabian Sea during 5-7th May 2004. The ability of the model in simulating these events as well as the mean monthly rainfall and their comparison with observed values from different satellites will be discussed. Forecast skill scores based on Root Mean Square Error (RMSE) and S1 Score have been computed. Results indicate many encouraging features and improvement in the forecast skill of the model over the monsoon regime.

THE INFLUENCE OF LAND SURFACE CONDITIONS ON THE MONSOON ONSET IN SOUTHEAST ASIA

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Abstract

The first transitions into the Asian Summer Monsoon (ASM) occur between late April and early May over inland Indochina, before any transitions occur along the coast. This study used a regional climate model to elucidate the influence of orography and ground wetness on subcontinental-scale hydrological processes. The model reproduced many elements of the onset of the Southeast Asia Monsoon (SEAM) associated with land surface conditions, including the early and abrupt onset observed when mountain effects and relatively dry soil conditions were combined in the model simulations. The nonlinear effects of mountains and ground wetness, combined with realistic increases in precipitation, can modify the hydrological cycle through changes in the surface energy budget. A positive feedback between soil moisture and precipitation increases the moisture source for further precipitation in the first transition period.

DIFFERENCES BETWEEN THE SOUTH AMERICAN AND INDIAN MONSOON CIRCULATION

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Abstract

The precipitation annual variability of the tropical region of South America has a well defined cycle for many areas from the equator south to 25°S, with a rainy season in summer time and a dry season in winter. This seasonal cycle shows characteristics of a monsoon system, with distinct wet and dry seasons. Because of this characteristic, some studies have been made to identify the changes in the atmospheric circulation between the dry and the rainy season. As Indian also is characterized by a clear monsoon circulation, the aim of our study is identify the similarities and the differences between the South American and Asian atmospheric circulation. The NCEP/NCAR reanalysis, pentad outgoing longwave radiation (OLR) and daily gridded precipitation analyses from NCEP are used in this study.

Preliminary results show as similarities: the development of the South American monsoon system (SAMS) starts during the austral spring season (September, October and November), the maximum rainfall intensity occurs during the summer (December to February) when deep convection develops over much of tropical South America; low-level (925-hPa) temperature is highest and specific humidity is lowest at the end of the dry season and beginning of the wet season (August-October); specific humidity begins to increase just before the onset of the rainy season, while low-level temperatures are near their maximum; the moisture transport has a maximum during austral summer months and a minimum during winter months; monsoon-related changes in the circulation also occur at the upper levels, during the winter the flow tends to be zonal while during the summer the flow is weaker and more meridional, especially near the east and west coasts of South America; during the austral spring a closed upper-level anticyclonic circulation develops rapidly over the northwestern Amazon; an outflow from this upper-level anticyclone streams northward into the Northern Hemisphere; the decay phase of the monsoon begins in late summer, as deep convection gradually shifts equatorward; during the austral fall season (March, April, and May), the low-level eastward flow of moisture from the western Amazon weakens, and more frequent incursions of drier and cooler air from the mid-latitudes begin to affect the interior of subtropical South America.

The differences observed are: the low-level winds do not reverse their direction over South America, just the zonal wind changes its direction, with easterlies during the dry season and westerlies during the rainy season; and the low level transient disturbances similar to monsoon depressions are not observed. The possible reasons for these differences are discussed.

A CORRELATION STUDY ON NORTH PACIFIC OSCILLATION AND EAST ASIAN SUMMER MONSOON

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Abstract

The criterion of establishment and withdrawal of East Asian summer monsoon in East and Northeast China is defined. When the pentad-averaged contours of 336K and 4 m/s south wind at 850 hPa along 122.5°E (or 117.5°E) time-latitude cross section are across 40°N(or other latitude) together, the pentads is defined as the established time of East Asian summer monsoon in Northeast (or East) China. And the summer monsoon index along a longitude is calculated as a normalized ratio value of the persistent pentads and yearly mean persistent pentads of 336K across a latitude when East Asian summer monsoon is established along a latitude. East Asian summer monsoon indexes along 117.5°E, 30°N, 35°N and 122.5°E, 40°E have a positive correlation with July-August precipitation in North of Huai River, North China and most of Northeast China respectively. The correlation statistics between and sea surface pressure North Pacific Oscillation index (defined as Wallace) NPOW have been analyzed. The results indicate that there is a negative correlation between the along 117.5°E, 30ºN and 35°N and lagging two seasons' winter NPOW (significant level >0.05), and a negative correlation between winter index NPOW and the lagging two seasons' indexes along 117.5°E, 30°N (significant level >0.05). All those indicate a closed relationship between NPO and strength of East Asian summer monsoon. Some correlation mechanisms are explored.

Key Words: North Pacific Oscillation, East Asian summer monsoon, Correlation

THE RELATIONSHIP BETWEEN SOUTH CHINA SEA SUMMER MONSOON INTENSITY AND SST AT DIFFERENT TIME SCALE

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Abstract

Wavelet analysis shows that SCS (South China Sea) summer monsoon intensity has two dominant oscillation period. One is interannual variation of 2-3 years and another is decadal variation of about 10 years. Decadal variation is primary from 1950s through the medial 1960s, interannual and decadal variations are comparative from late 1960s to early 1990s, and interannual variation is leading after the beginning of 1990s. Wavelet variance shows that 5 years period is the energy gap of SCS summer monsoon intensity. 5-years is regarded as cutoff period. Using Lanczos filtering, both SCS summer monsoon intensity and SST sequence are respectively decomposed into two corresponding sequences at interannual and decadal scale. Area of high correlation with SCS summer monsoon intensity is great difference in SST at different time scale. High correlation area concentrates at equatorial region of Pacific, Indian and Atlantic at interannual scale. At decadal scale, high correlation area mainly occurs at medial and high latitudes and seldom near equator. Besides Pacific and Indian, remarkable high correlation happens at Atlantic, especially north Atlantic.

THE RELATIONSHIP BETWEEN THE SOUTH CHINA SEA SUMMER MONSOON AND TROPICAL CYCLONE LANDFALLING THE SOUTH CHINA

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Abstract

This paper showed that what the character of the South China Sea Summer Monsoon Index and the frequence of tropical cyclone landfalling the South China by using Mhat wavelet is. The results indicated there were two-years and ten-years or so period for the monsoon index, and there were two-three years and seven-ten years period for the frequence of tropical cyclone landfall. By comparing the monsoon index with the frequence of tropical cyclone, it was showed that the relationship of the monsoon index and tropical cyclonic frequence was better at the decadal years scale than at other time scales. The result suggested that the tropical cyclonic frequence would be much more in the year of the monsoon index stronger and earlier.

RELATIONS BETWEEN QUASI-BIENNIAL OSCILLATION AND INTERDECADAL VARIABILITY OF SUMMER PRECIPITATION OVER SOUTH CHINA AND THE EFFECTS OF SUMMER MONSOON OVER SOUTH CHINA SEA

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Abstract

There is obvious Quasi-Biennial variability both in summer precipitation over South China (SCSPR) and Summer Monsoon over South China Sea (SCSSM). And interdecadal variations of averaged SCSPR variance in quasi-biennial oscillation play an important role on their interdecadal variations after 1970s. Commonly, the larger variance corresponds on the more precipitation, and vice versa. But there is not clear relation before then. The analyzed results suggest that it is due to interdecadal variation of the quasi-biennial relationship between SCSPR and SCSSM. In the interdecadal phase of 1953-1976, they exhibit weak negative correlation in the quasi-biennial scale, while there is strong positive correlation in the non-biennial scale; in 1977-2000, TBO of SCSPR and SCSSM vary in phase, and they are not clear relation in the non-biennial scale. Further analysis indicate that the catastrophe of general circulation in 1970s make quasi-biennial variation of SCSPR great important in its interannual scale.

STRONG SIGNAL OF EVOLUTION OF EAST ASIAN SUMMER MONSOON ON THE LOESS PLATEAU IN THE PAST 2.6MA

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Abstract

This paper introduces the method of singular spectral analysis (SSA), which can quantificationally detect the period, into the research on periodic evolution of East Asian summer monsoon on the Loess Plateau in the geological periods, and makes study on the strong signal of East Asian summer monsoon in the past 2.6Ma by using the wavelet analysis into the susceptibility of traditional loess-paleosol from Luochuan section and Lingtai section. Results show that the leading period of evolution of East Asian summer monsoon is 40Ka and the stage from 0.9 to 0.6MaB.P. is an adjustive and transitional period of 40Ka and 100Ka cycle in the geological period from 2.6MaB.P. to 1.0MaB.P. except the stage from 1.37MaB.P. to 1.87 MaB.P., in which there exists an absent period of inconspicuous evolution, with 100Ka leading cycle over the past 0.6MaB.P.. Moreover, it is found that there is no marked discrepancy for the cycle around 1.2MaB.P., indicating that 1.2MaB.P., in fact, is not a shifting event of the cycle but a triggering one during the periodic evolution, which makes a deep impact on the shifting event of the cycle after 0.9 MaB.P.. ~40Ka cycle comes to weaken at 1.2MaB.P., ~100Ka cycle intensifying at 0.9MaB.P., and East Asian summer monsoon emerging ~ 100Ka cycle followed by the warm-cold large amplitude at 0.6MaB.P., thus indicating that the stage of 0.6MaB.P. has characteristic of break of aggravating climate oscillation.

Key words: the Loess Plateau; Wavelet analysis; Singular spectral analysis; Susceptibility; Monsoon change

黄土高原 260 万年以来东亚夏季风演变的强信号研究

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摘 要

本文在研究黄土高原东亚季风地质时期周期演变中，引入了定量检测周期的奇异谱分析（SSA）方法，并结合小波分析，对典型的黄土高原——陕西省洛川黄土—古土壤剖面、甘肃省灵台剖面的磁化率中，2.6Ma 以来东亚季风的强信号进行了研究。结果表明：

2.6MaB.P.以来，东亚季风进入盛行期，洛川、灵台磁化率的小波分析表明，2.6-1.2 MaB.P.东亚季风主要以 40Ka 的周期振荡为主，显示出黄赤夹角对东亚季风的演变起着主导作用。在 1.2MaB.P.前后，SSA 分析表明并没有明显的周期差异，因而认为 1.2 MaB.P.不是一次真正意义上的转型事件，而是一次周期变化的触发事件，受它的影响，40Ka 的周期开始减弱，并在 0.9-0.7 MaB.P.期间崩溃，同时孕育着 100Ka 周期出现，但 100Ka 周期并不显著。小波分析表明，40Ka 周期到 100Ka 周期转型并不是突然的，而是有一较长的过渡时期，在这一过渡时期内，季风气候演变的周期性不是十分清楚。只有在 0.6MaB.P.前后，100Ka 周期才真正得以建立，0.9-0.6 MaB.P.期间东亚季风的演变表现平缓，而 0.6MaB.P.开始的东亚季风振幅增大，冷暖变化强烈，这与中更新世以来冰期与间冰期气候交替出现的特征是完全吻合的。

SSA 从统计角度，检验了各地质时期的准周期存在的显著性，结果表明 2.6-0.77 MaB.P.期间主要显示出 40Ka 的周期变化，1.2 MaB.P.前后的周期没有显著的差异，这进一步证明 1.2 MaB.P.不是一次转型事件，而是一次触发事件。40Ka 周期在 2.6-0.77 MaB.P.的大部分地质时期内都通过显著性检验，但在 1.37-1.87 MaB.P.灵台的磁化率没有检测到周期，洛川磁化率的 20Ka 周期也不显著，小波分析图上显示这段时期等直线稀疏，振幅较小（正负值小）。对于学术界有争议的 100Ka 周期建立的时间，奇异谱分析的结果与小波分析是一致的，即从 1.2 MaB.P.的触发事件开始，40Ka 周期逐渐衰减，并从 0.9 MaB.P.开始崩溃，0.9-0.6 MaB.P.期间是 100Ka 周期与 40Ka 周期的调整期，0.9 MaB.P.开始已有 100Ka 周期的迹象，但 SSA 分析表明周期不显著，只有在 0.6 MaB.P.开始，100Ka 周期变得显著，成为东亚季风演变的强信号。

THE CORRELATIONS FOR EAST ASIAN MONSOON AND THE CLIMATE OF ZHEJIANG PROVINCE

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Abstract

According to the sea level pressure offered by National Climate Center and the surface climatic data of Zhejiang Province, the winter monsoon index and the summer monsoon index are calculated by Guo Qixun's method · the correlations for East Asian Monsoon and the climate of Zhejiang Province are discovered:

(a)There are very strong seasonal and decadal characteristic in the correlations of East Asian Monsoon and the rainfall or temperature of Zhejiang Province.

In August and September the winter monsoon appeared earlier, the rainfall will be more than average and the temperature will be lower than average. In October when the winter monsoon is strongest or weakest，the Zhejiang Province rainfall will be less than average. From November to January, when the winter monsoon is above average, the rainfall will be less than average and temperature will be lower average, and there will be dry and clod winter, and when it is weaker than average, they will be above average, and there is warmer winter in Zhejiang Province. From February to April the rainfall will be less than average and the temperature will be lower than average when the winter monsoon is strongest, and they will be above average when it is weakest.

From February to March when the summer monsoon appeared earlier, the rainfall will be more than average and temperature will be above average. In April the rainfall will be more than average and temperature will be above average when the summer monsoon is stronger, and they will lower than average when the summer monsoon is weaker. From May to June when summer monsoon is strongest and weakest, the rainfall will be less than average, and when it is stronger, the rainfall will be more than average and temperature will be lower, and when it is weaker, rainfall will be less than average and temperature will be above average. From July to September when it is stronger, the rainfall will less than average and temperature will be above average, and there will be hot and dry summer, and when it is weaker, the rainfall will more than average and temperature will lower than average, and there will be cool and rainy summer at Zhejiang province.

(2)When the monsoon is stronger, the effect of the typhoon will be weak ,and when it is weaker, the effect of the typhoon will be stronger in Zhejiang province.

CORRELATIONS BETWEEN THE PRECIPITATION IN SHANGHAI AND SST OVER THE PACIFIC AREAS AND THEIR INTERDECADAL VARIATIONS

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Abstract

Correlations between the winter (summer) precipitation in Shanghai and the SST over Pacific areas and their interdecadal variations from 1873 to 2001s have been analyzed in this paper .The results indicate that the correlations between the Shanghai's precipitation and the SST over pacific areas are significantly different on different time scales and different areas. Major results are as follow:

(1) There are significant interdecadal variations in winter (and summer) precipitation during the century, but the increased trend is not obvious. From the late 80s, It is rainy in interdecadal scale. The annual precipitation variations are positive.

(2) The correlations between the winter (summer) precipitation in Shanghai and the SST over Pacific areas in middle 40s, in particular , is mainly positive before the middle 40s ,but it is opposite after the middle 40s .The seasonal difference in the correlations between winter precipitation and the average SST over Nino areas is remarkable. It is mainly positive in summer and autumn. But the interdecadal variations are distinct after 70s.Thus it can be seen that the interdecadal difference in correlations between the winter (summer) precipitation in Shanghai and the prophase SST in Nino areas are obvious.

(3) By discussing the correlations between winter (and summer) precipitation in Shanghai and the prophase and the corresponding period SST over Pacific areas , results show that there are great difference in the correlation in different time scale and different areas, furthermore the difference is significant in annual and interdecadal correlations.

In all, the remarkable correlations difference on different time scales and different areas possibly lead to uncertainties and inaccuracy in statistical forecasting . It is in favor of making use of data on SST to traversing the correlation difference, which will reduce the uncertainties and the promote the accuracy in forecasting.

Key words: Winter and summer precipitation in Shanghai; Sea surface temperature over the Pacific area; Interdecadal difference of correlations

近百年来上海冬夏季降水与太平洋海温的相关关系及其年代际差异

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摘 要

利用上海 1873-2001 年的冬季和夏季降水量和同期 NCEP 再分析的太平洋海温场的格点资料，通过计算上海冬（夏）季降水与太平洋格点海温的同期相关和超前相关系数分布，以及上海降水与太平洋 Nino 海区海表区域平均温度的滑动相关系数序列，讨论上海（冬）夏季降水与太平洋海温场的相关关系在不同时间尺度上和空间区域上的显著差异。

（1）百余年来上海冬（夏）季的降水存在明显的年代际阶段性变化，但总体雨量增加的趋势不明显，80 年代后期开始，在年代际尺度上处于多雨期，年变化上看在 90 年代后期冬（夏）季降水均以正距平为主，最大年距平百分率冬夏均达 1.5 左右。

（2）上海夏季降水与前期 Nino 海区的区域平均海温的相关关系在 40 年代中期均发生了阶段性的变化，特别是上海夏季降水与前一年夏秋季 Nino 区海温 40 年代中期前以显著正相关为主，40 年代中期后以负相关为主。冬季降水与各 Nino 区平均海温相关季节差别显著，其中夏秋季以正相关为主，但在 70 年代后有较大的年代际差别，由此可见上海冬（夏）季降水与前期 Nino 区海温的相关关系的年代际差别明显。

（3）由上海冬（夏）季降水与太平洋海温场同期及前期海温的相关分析，可以看到，降水与太平洋海温场的相关关系在时间及空间上都存在较大的差异，同时在年际尺度和年代际尺度上的相关关系差别也非常显著。

由上述结论分析，在时间尺度及空间尺度上存在的显著的相关关系差异有可能是导致海温场在短期气候统计预测中不确定性的主要原因之一，而详细考虑其相关差异，必将有利于更好的应用海温场资料，减少预测中的不确定，从而提高预测的准确性。

关键词: 上海冬夏季降水；太平洋海温； 年代际差异

THE RELATIONSHIP BETWEEN THE NONUNIFORMITY OF STRUCTURE OF MEIYU FRONT AND VORTEX DISTURBANCE ALONG THE FRONT

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Abstract

In early summer, with the seasonal adjustment of atmosphere general circulation, especially with the north jumping of West Pacific subtropical high and East Asian monsoon, the rainy season was coming at the middle-lower reaches of Yangtze River. This was called Meiyu season. Meiyu front was a macro-scale system, and it was not uniform. It resulted in sustained rainfall. The nonuniformity of Meiyu front closely related with macro-scale system and mesoscale convective system. Meiyu front and vortex along front influenced each other. In order to improve the forecast accuracy, Meso-scale model MM5, intensive observation data, TBB data were used in studying the relationship between the nonuniformity of structure of Meiyu front and vortex disturbance during the last ten-day of June 1999. The main results were as follows.

The intensity of Meiyu front and rain belt along it was not uniform. There was a good relationship between the mesospheric front and the vortexes along it. The maximum vorticity value was at 850hPa, and the strongest front was at 750hPa. The mesospheric front at 750hPa nearby was stronger than boundary layer front. Along the mesospheric front, there was a sharp contrast of humidity. Low vortex was sensitivity to the change of mesospheric front, and they changed almost at the same place. If we changed the intensity of mesosphere front, the intensity of mesospheric front would change with inphase. For instance, if the intensity of mesospheric front was developed, low vortex would strengthen than before.

The mesospheric front could foreshow the evolution of vortex, especially the south-west vortex. As for south-west vortex, the development of vortex and Meiyu front was not at the same time. The frontogenesis appeared about 6 hours or more earlier than the development of vortex. The maximum of intensity of front appeared earlier than the maximum of precipitation too. Sensitive experiments proved that the development of mesospheric front would influence the development of vortex 6 hours later. As for local vortex, the development of vortex and Meiyu front occurred almost at the same time.

The location that mesospheric front was strongest was near to the place that low vortex was strongest, so the front developed most at just the north where the low vortex developed lately. Before the low vortex developed most, mesospheric front went on developing at the same place almost no displacement, and the vortex would be strongest in the same place in the future. It means, when mesospheric front went on developing at a place, and there was a vortex developed on its west, the vortex would be strongest at that place in the future. When low vortex past by, the mesospheric front propagated eastern and weakened, which would be useful for vortex storm forecast.

Key words: nonuniformity; Meiyu front; South-west Vortex; local vortex; sensitivity experiment

梅雨锋结构特征不均匀性及与锋上涡旋扰动的联系

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摘 要

初夏季节，随着大气环流形势的季节调节，特别是西太平洋副高的季节性北跳，东亚季风的加强北上，长江中下游地区进入雨季，即梅雨季节。梅雨锋作为导致长江中下游梅汛期降水最为稳定持续的大尺度系统，并不是一个均匀的带状系统。梅雨锋的不均匀性与梅雨锋及附近的天气尺度系统和梅雨锋上的中尺度对流系统的发展密切相关，梅雨锋与低涡之间是相互作用、相互影响的。为了加强对梅雨锋和低涡的了解，提高梅雨降水的预报能力，我们利用全程同化的中尺度数值模式的时空高分辨模拟结果揭示梅雨锋的不均匀结构及其与扰动的联系；用 TBB 和野外试验的加密观测资料检验同化诊断结果；用敏感性试验深入分析其过程。运用以上资料方法，我们对 1999 年 6 月下旬的梅汛期过程进行研究，探讨梅雨锋沿锋面方向结构的不均匀性及其与涡旋扰动变化的关系，得到以下一些新的认识：

梅雨锋及其伴随雨带的强度在东西方向是不均匀的。梅雨锋主要表现为中层锋面，中层梅雨锋的位置在 750 hPa 附近，以湿度对比为主，强度比边界层锋强。低涡的涡度中心基本在 850hPa 的低层附近，比中层梅雨锋的位置低。敏感性试验表明，低涡对中层锋面强度的变化敏感，两者发生变化的位置基本一致。中层锋强发生改变会导致整层涡度发生同位相的变化，中层锋强增强会使整层涡度增强，中层锋面沿锋不均匀特性对涡旋降水的影响比边界层锋更关键。

中层锋强对低涡发展有预示作用，对西南涡和局地涡这两类低涡发展的影响又有所区别。对于发展过程中东移明显的西南涡，低涡和梅雨锋强度的加强并不是同时的，梅雨锋锋强最大比低涡涡度最强出现提早 6 小时以上，锋面最强也比降水最强出现早。敏感性试验证明，中层锋面强度改变对低层的低涡发展造成影响也在 6 小时以后。对于长江中游局地生成发展的局地涡，锋面最强与低涡最强出现的时间比较接近，锋面最强略有超前，但幅度不如西南涡大。

梅雨锋中层锋面发展最强的位置与低层低涡发展最强的位置在东西方向上基本重合，因此低涡暴雨扰动多发区的北侧也是锋生的多发区。低涡发展前期，在未来低涡发展最强的地区附近，中层梅雨锋持续加强，并且这条锋面加强带在东西方向上基本不发生位移；当低涡移经该地时，低涡强度发展到最强，随后低涡东移并且强度减弱，锋面大值带也减弱并随低涡向东传播。这对预报低涡发展有指示作用：当中层锋面强度在某地持续维持大值，它的西侧又有低涡发展东移，则该地就是未来低涡强度最强的位置，低涡移经该地后强度减弱。

关键词：不均匀性；梅雨锋；西南涡；局地涡；敏感性试验

A DIAGNOSTIC STUDY OF MONSOON INTRASEASONAL OSCILLATION BY USING OBSERVATIONAL DATA OF XISHA STATION IN THE SOUTH CHINA SEA

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Abstract

With the Lanczos filter and wavelet transform methods, the observational daily rainfall for the period 1958-2000 and winds at 850 hPa level for the period 1980-2001 of Xisha station (112.2°E, 16.5°N) in the north of South China Sea are used to study the intraseasonal variability of monsoon in the South China Sea. It is shown that the daily rainfall and winds at 850 hPa level have about 10~50 days timescales intraseasonal oscillation (ISO), and the ISO has a prominent annual and interannual variation. The rainfall ISO starts in the middle of May and ends in the middle of October, which time is consistent with the time of summer monsoon onset and ending in the South China Sea. The 850 hPa winds ISO exists nearly in all year. And the strong and weak years of the rainfall and 850 hPa winds ISO are inconsistent with the strong and weak years of summer monsoon in the South China Sea. The study shows that summer monsoon in the South China Sea exists ISO, but the relationship of summer monsoon and ISO is complex.

Key words: rainfall and 850 hPa winds of Xisha station, Lanczos filter and wavelet analysis, Monsoon ISO.

SIMULATION OF REGIONAL FEATURES OF THE INDIAN SUMMER MONSOON IN A GCM

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Abstract

Major characteristics of Indian summer monsoon climate are analyzed using simulations from the upgraded version of Florida State University Global Spectral Model (FSUGSM). The Indian monsoon has been studied in terms of mean precipitation and low-level and upper-level circulation patterns and compared with observations. In addition, model's fidelity in simulating monsoon intraseasonal and interannual variability and the teleconnection patterns associated with the monsoon interannual variability is examined.

The model is successful in simulating the major rainbelts over the Indian monsoon region. However, the model exhibits bias in simulating the precipitation bands over South China Sea and West Pacific region. Seasonal mean circulation patterns of low-level and upper-level winds are consistent with the model's precipitation pattern. Basic features like onset and peak phase of monsoon is realistically simulated. Model simulation indicates an early withdrawal of monsoon. Northward propagation of rainbelts over the Indian continent is simulated fairly well, but over the ocean propagation is weak. Model simulates the meridional dipole structure associated with the monsoon intraseasonal variability realistically. Model is unable to capture the observed interannual variability of monsoon. Analysis of teleconnection patterns reveals models fidelity in simulating the component of interannual variability forced by sea surface temperature.

HYDROLOGICAL CHANGE UNDER THE GLOBAL WARMING IN ASIA WITH A REGIONAL CLIMATE MODEL NESTED IN A GENERAL CIRCULATION MODEL

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Abstract

We have developed a regional climate model, NIES-RAMS, and conducted present and future Asian regional climate simulations which were nested in the results of Atmospheric General Circulation Model (AGCM) experiments. The regional climate model could capture the general simulated features of the AGCM and also some regional phenomena such as orographic precipitation, which were not appeared in the outcome of the AGCM simulation, were successfully produced.

The increases of annual mean surface runoff and its large fluctuations are projected in a lot of Asian regions. The seasonal mismatch between water demand and water availability, which should be considered in future water resource assessments, is concerned.

INTRASEASONAL OSCILLATION OF SOUTH CHINA SEA CONVECTION AND ANOMALOUS GENERAL CIRCULATION OF ATMOSPHERE

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Abstract

The relationship between intraseasonal oscillation of South China Sea convection and anomalous general circulation of atmosphere is discussed using two data sets of 18-year TBB (black body temperature) of satellite remote sensing data and NCEP/NCAR reanalysis. Analyses show that intraseasonal oscillation intensity of South China Sea convection impacts general circulation of atmosphere definitely. This is embodied by the obvious difference of general circulation of atmosphere between strong intraseasonal oscillation intensity of South China Sea convection and weak intraseasonal oscillation intensity of South China Sea convection.

LONG-TERM TREND OF HEAVY PRECIPITATION IN JAPAN AND A POSSIBLE RELATIONSHIP WITH CHANGE OF LARGE-SCALE FIELDS

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Abstract

Using ranked precipitation data as well as monthly, daily and hourly precipitation data for more than 50 years in Japan, long-term trend of heavy precipitation is studied.

There are strong inter-decadal variations and sharp increase in the 1930s in frequency of heavy precipitation events in Japan. Variations of extreme precipitation events during 10 minutes, one hour, and one day have similar inter-decadal variations, while their linear trends are different. Trend patterns of heavy precipitation in early and late summer are different, particularly in central Japan. The trend of heavy precipitation is positive (negative) in late (early) summer.

These trends are compared with change of the summer-time large-scale fields in the East Asia in the past summer 50 years, inferred from ERA40 and JMA archived 500 hPa geopotential height fields. Main changes of the summer-time large-scale fields are intensification of the geopotential height in the subtropics and strengthening of the Ohotsuku High to the north of Japan. These changes may be consistent with the trend features found in summer of heavy precipitation in Japan.

ENSO-RELATED SUMMERTIME 30-60-DAY OSCILLATIONS OF CONVECTION OVER THE TROPICAL WESTERN NORTH PACIFIC AND INDIAN OCEAN

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Abstract

This study finds the out-of-phase feature of 30-60-day oscillations of atmospheric convection over the South China Sea and tropical western North Pacific during summer, between the warm and cold or neutral ENSO cases in the preceding winter. The phase of the composite oscillations for warm cases is two or three pentads lagged to that for cold and neutral cases. The phase-locking feature of 30-60-day oscillations shown by previous studies essentially results from cold and neutral ENSO cases. Over the northern Indian Ocean, in contrast, the phase of the composite oscillations for warm cases is similar to that for neutral cases, but is one or two pentads lagged to that for cold cases. The ENSO-related phase of 30-60-day oscillations is explained by the annual cycle of zonal winds over the tropical western North Pacific and northern Indian Ocean. The 30-60-day oscillations are found to be more exactly phase locking to the annual cycle of atmospheric circulation than to the calendar annual cycle. The existence of the relation between the phase of intraseasonal oscillations and ENSO is encouraging for subseasonal forecast of the Asian summer monsoon.

INVESTIGATING THE ORIGIN OF WATER VAPOR IN NORTHERN ARGENTINA DURING SALLJEX EXPERIMENT

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Abstract

Most of the population and the economic activity of Brazil, Uruguay, Paraguay and Argentina are located within Southeastern South America. Agricultural products and energetic resources from this region supplies the needs of most of the population living in these countries and constitute a large fraction of their exports. These resources are directly dependent on rainfall. The origin of the water vapor entering at low levels in this subtropical area comes from the tropical continent or from the Atlantic Ocean. The Andes Mountains channels the easterly low-level flow towards the south between the Bolivian Plateau and the Brazilian tropical forest, advecting warm and humid air to southern Brazil, Paraguay, Uruguay and subtropical Argentina. Sometimes, this flow is enhanced and an intense low-level jet develops, advecting humid and warm tropical air into higher latitudes. This is one of the most relevant features of the South American monsoon.

A possible alternative to discriminate the origin of water that precipitates in a region at a particular season is to analyze its isotopic content. The stable isotopes deuterium and oxygen-18 offer a broad range of possibilities for studying processes of the water cycle. One of them is to determine the source of the water vapor analyzing the content of stable isotopes in rainfall water or relating them to environmental variables associated to the water source region. The basis for this methodology is that the isotopic content is related to the air mass back-trajectory. When the humid air moves from the oceans to the continent, it is progressively depleted of isotopes as precipitable water is lost on the way in the form of rainfall.

In this research, the identification of the geographical origin of the water vapor over subtropical Argentina was determined. The data were obtained during the South America Low Level Jet Experiment (SALLJEX) in January and February 2003. During the experiment, daily rainfall samples were collected in two Argentinean stations: Salta and Resistencia and the isotopic contents were analyzed by the Environmental Isotopes Laboratory, from INGEIS (CONICET-Argentina). The possible air mass back-trajectories that finally generate rainfall events, which samples were collected, were calculated using a three-dimensional kinematic trajectory model. In this model the trajectories, are calculated using the zonal, meridional and vertical wind velocity. The wind field was derived from the meteorological model, named Regional Atmospheric Modeling System - RAMS.

The trajectories predicted by the model and the isotopic content permitted to identify the origin of water vapor and classified the rainfall events in continental or Atlantic source. This research is one more contribution to the understanding of the South America summer circulation and its rainfall features associated.

ANALYSES OF PRECIPITATION FEATURE AND CAUSES FOR TROPICAL CYCLONES IMPACTING ZHEJIANG PROVINCE

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Abstract

Tropical cyclones (TC) affect Zhejiang province almost every year, but their impacting extents, such as precipitation intensity and distribution, are different. On the need of operational forecast for impacting TC, all the tropical cyclones(203) impacting Zhejiang province from 1949 to 2003 were analyzed statistically and classified according to the impacting extent and TC tracks. Once more, the detailed analyses were conducted on the atmospheric circulation feature, physical quantity diagnoses and satellite images for every type of TC tracks in order to find some skill for practical TC precipitation forecast.

Here, an impacting TC is defined as TC which brings Zhejiang province rainfall of more than 50mm or gale over 20m/s at least one station. According to the definition, there are 203 impacting TCs in Zhejiang province from 1949 to 2003. They were classified 5 categories and ten types. 1) TCs which landed in Zhejiang province and moved north (19) 2) TCs which landed in Zhejiang province and moved west (13) 3) TCs which landed in Fujian province and moved north into Zhejiang province or the west to Zhejiang province(33) 4) TCs which landed in Fujian province and moved west(23) 5) TCs which died after landing in Fujian province or moved north into southern Zhejiang province and died (15) 6) TCs which landed in Guangdong province and moved north into Zhejiang province(9) 7) TCs which landed in Guangdong province and moved west(9) 8) TCs which landed in Guangdong province and moved north into Jiangxi or Fujian province where they died 9) TCs which moved north near the coast of Zhejiang province (61) 10) Others (10). Of all the impacting TCs, the most severe to Zhejiang province are those landing in Fujian and Zhejiang provinces.

Mostly, TC precipitation is well related to its track and intensity. For example, TCs which landed in Guangdong province and moved west had impact on Zhejiang province only when they were very strong (the near-center gale is over 33m/s); Suffering TCs which landed in Fujian province and moved north into Zhejiang province, Zhejiang province always got rainfall of more than 100mm in large regions. However, it was not all the case. On some situations, TCs with similar tracks gave different precipitation feature. So, all those TC cases were analyzed and it was found that apart from TC tracks and intensity, the precipitation feature of TC was well correlated with the factors of atmospheric circulation backgrounds, environmental conditions of Zhejiang province, westly trough, subtropical high over the Northwest Pacific Ocean and interaction between TC and westly systems/subtropical systems. The conclusion is useful to operational TC precipitation prediction.

Key words: Tropical Cyclones Precipitation Feature Precipitation Causes

影响浙江省热带气旋的降水特征和成因分析

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摘 要

浙江省每年都要受到热带气旋的影响，但影响程度不尽相同。本文利用 1949-2003 年 55 年的台风（热带气旋）年鉴资料，对影响浙江省的热带气旋进行统计分析，并按影响程度和路径分类；在此基础上，对各种路径热带气旋的大气环流特征、物理量诊断结果和卫星云图进行详尽的分析，试图找出对台风降雨的业务预报有指导意义的技巧和指标。

我们定义：使浙江省出现一个站以上过程降水量超过 50 毫米或 8 级以上大风的热带气旋为影响热带气旋。据此定义，1949-2003 年浙江省共有 203 个影响热带气旋。我们将其路径归纳为五类十种。一类登陆浙江：（1）登陆浙江后北上（19 个）；（2）登陆浙江后西行（13 个，其中 1 个快速消亡）。二类登陆福建：（1）登陆福建后北上经过浙江或浙江以西抛物线行转向东北（33 个，其中 28 个经过浙江）；（2）登陆福建后西行（23 个）；（3）登陆福建后快速消亡或北上在浙南消亡（15 个）。三类登陆广东：（1）登陆广东后北上经过浙江（9 个）；（2）登陆广东后西行（9 个）；（3）登陆广东后北上在江西或福建境内消亡（11 个）。四类近海北上（61 个）。五类台湾海峡消亡（5 个）或其他（5 个）。其中对浙江影响最为严重的是登陆福建和登陆浙江类。

多数情况下，热带气旋的降水与其路径和强度有较好的相关性。如：登陆广东后西行或在台湾海峡消亡的热带气旋其强度必须达到或超过台风才会对浙江省有影响。登陆福建后北上经过浙江的热带气旋均会给浙江省带来大范围的大暴雨。因此，以上分类对业务预报极为有用。但某些情况下，路径相似的热带气旋的降水差异很大。如 5612、8807 和 0008 台风均在象山登陆，但 5612 台风影响期间，浙江省有 30 站过程雨量超过 100 毫米，最大 694 毫米；8807 台风影响期间，浙江省有 10 站过程雨量超过 100 毫米；而 0008 台风影响期间，浙江省只有 2 站过程雨量超过 100 毫米。再如热带气旋飞燕和桃芝也是路径相似，降水各异。通过对这些个例进行环流形势对比分析、物理量诊断分析和卫星云图分析，发现除了热带气旋的路径、强度外，热带气旋影响地的前期环境场，热带气旋影响期间西风带低槽和副热带高压的强弱及其相互配置以及它们与热带气旋的相互作用是影响热带气旋降水的主要因子。

关键词：热带气旋 降水特征 成因分析

LONGITUDINAL DISPLACEMENT OF THE SUBTROPICAL HIGH IN THE WESTERN PACIFIC IN JUNE AND ITS INFLUENCE

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Abstract

As the most important general circulation system of low latitude, the activity of the Subtropical High (STH) in the western Pacific strongly influences the summer climate in China. The longitudinal position of STH affects the temperature and precipitation in East China. Actually, the anomalous position of STH in the longitudinal direction strongly relates to the date of summer monsoon onset in eastern Asia, rainfall in the Yangtze River Valley and temperature in North China. However, only a few studies focus on the longitudinal displacement of STH. So it is an important problem for meteorologists to study the variation rules of the western Pacific STH and then reveal its mechanism and at last to make the forecast accurately.

In terms of the NCEP reanalysis monthly data, the monthly mean rainfall and temperature data at 160 stations of China. Using the relative vorticity averaged over a certain area, a new index for measuring the longitudinal position of the STH in the western Pacific is proposed. Some interesting phenomena have been found. Major results are as follow:

(1) The years of extreme westward and eastward extension of STH in June using the new index are in good agreement with those defined by height index. We use the relative vorticity averaged in the area of ( ) as an index of the longitudinal position of STH to measure the longitudinal movement of the west end of STH. A lager negative relative vorticity or negative relative vorticity anomaly of that area means that the STH extends westward. A smaller negative relative vorticity or positive relative vorticity anomaly indicates that the STH extends eastward.

(2) There exists a distinct difference in large-scale circulation between the eastward and westward extension of STH under the new definition. It seems that when the STH extends far to the west (east), equatorial westerly is weaker (stronger), cross-equatorial flow is weaker (stronger), South China Sea summer monsoon is weaker (stronger), the Yangtze River Valley westerly is stronger (weaker), which has the positive (negative) effect on the maintenance of rain band over the Yangtze River Valley, so the rainfall is more (less) in this area and it is hit by floods (droughts), vice versa.

(3) There exists a good relationship between the longitudinal position of STH and the rainfall and temperature in June in eastern China. A remarkable negative correlation area appears in the Yangtze River Valley indicating that when the STH extends westward (eastward), the precipitation in that region increases (decreases). A positive correlation region is found in South China, showing the decrease of rainfall when the STH extends westward. The calculation of correlation coefficients between the index of longitudinal position of STH and surface temperature in China shows that a large area of negative values covers the South China and Szechwan Basin. This means the temperature of that areas increase when the STH extends westward.

Key words: the Western Pacific Subtropical High (STH), the index of longitudinal position of STH , the relative vorticity averaged in the key area, South China Sea summer monsoon, the rainfall and temperature in June in eastern China.

六月份西太平洋副高东西活动特征及其影响

罗玲

浙江省气象台

摘 要

夏太平洋副热带高压（以下简称西太平洋副高）是低纬度最重要的环流系统，特别是作为东亚季风环流系统中最重要的一员，其季节性的移动与东亚季风及季风雨带有着密切的关系，其位置和强度的变化是控制我国东部地区天气和气候的重要因素之一。尤其是西太平洋副高东西向位置和进退关系到东亚季风的建立、长江流域降水的多寡以及华北、华南地区的气温和旱涝。因此研究副高，特别是西太平洋副高的活动规律一直是中国气象学家的重要课题。

本文利用 NCEP 再分析月平均资料和中国气象局提供的 160 站降水和温度资料，通过计算关键区相对涡度，提出了一种新的指数来表征六月份西太平洋副高的东西向位置。重点讨论了副高东西向进退规律与大尺度环流的关系及其对我国东部天气的影响。主要结论如下：

（1）本文定义了关键区六月份的平均相对涡度作为描述副高东西位置的新指数。结果表明用新指数定义的六月份副高东西位置异常年份与常用的高度场定义的西伸脊点指数选出的异常年份基本上是一致的。当关键区负涡度值增大或呈负距平，说明该年六月份副高偏西；当该关键区负涡度值减小或呈正距平，说明该年六月份副高偏东。

（2）本文运用定义的副高东西位置指数研究了六月份副高东西异常年份的大型环流特征。风矢量场和相关场分析结果表明：副高偏西（东）年，赤道西风减弱（增强），越赤道气流偏弱（增强），南海夏季风偏弱（强），而长江流域西风增强（减弱），有（不）利于雨带在江淮流域维持，该地区降水偏多（少）易涝（旱）。

（3）研究了副高东西位置指数和我国东部六月份降水和气温的关系。结果表明：该指数与长江流域六月份的降水呈显著的负相关，而与华南地区的降水呈正相关。当副高偏西时，长江流域降水偏多，华南地区降水偏少；当副高偏东时，长江流域降水偏少，而华南地区降水则偏多。该指数与气温的相关表明：该指数与华南及四川盆地呈显著的负相关。当副高偏西时，该地区气温偏高。

关键词：西太平洋副热带高压, 东西位置指数, 关键区相对涡度,南海夏季风, 东部降水和气温

SATELLITE DATA ANALYSIS AND NUMERICAL SIMULATION OF TROPICAL CYCLOGENESIS IN THE WESTERN NORTH PACIFIC: ROLE OF ROSSBY WAVE ENERGY DISPERSION

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Abstract

The structure and evolution characteristics of Rossby wave trains owing to tropical cyclone (TC) energy dispersion are revealed based on the QuikSCAT and TRMM Microwave Image (TMI) data. Among 34 cyclogenesis cases in the western North Pacific during 2000-2001 typhoon seasons, 6 cases were associated with the Rossby wave energy dispersion of a pre-existing TC. The wave train is in general oriented in a northwest-southeast direction, with alternating cyclonic and anticyclonic vorticity circulation and a typical wavelength of 2500km. A new TC is observed to form in the cyclonic vorticity region of the wave train. We further note that not all TCs have Rossby wave trains in their wakes. The occurrence of the Rossby wave train depends, to a certain extent, on the TC intensity and the basic-state flow. Whether a Rossby wave train can finally lead to cyclogenesis depends crucially on the large-scale field in which the wave train evolves. The stronger low-level convergence/vorticity and greater mid-tropospheric moisture are among the favorable large-scale environmental conditions.

Numerical experiments with a hurricane model are further conducted to simulate 3D Rossby wave energy dispersion and associated cyclogenesis process. It is found that a new TC can be generated in the Rossby wave train when it is allowed to interact with a basic flow similar to the observed monsoon gyre or monsoon shear line. The simulated new TC has realistic TC structures such as spiral cloud bands, asymmetric winds, a warm core and eye wall. No cyclones can be generated when a resting environment is specified, indicating the importance of the Rossby wave train-mean flow interaction. A vorticity budget is diagnosed to reveal fundamental processes that give rise to the cyclogenesis in the model.

CLIMATE CHANGE AND ADAPTATION OF WEN ZHOU REGION

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Abstract

From the change of climate, though analysing the changes of temperature , precipitation and landing typhoon, we discovered that the temperature departure rises and precipitation departure of June increases of WenZou obviously. For lately twenty years, the percentage of landing typhoon rises clearly. So the conclusion is the region affected by the equatorial convergence belt and the secondary tropical anticyclone is extended northerly gradually. Lastly, we would touch on the problem of countermeasure.

1. The changes of temperature

The global average surface temperature has increased over the 20th century by 0.6°C As the same as the global average surface temperature, for chart 1, the average temperature is high continuously after 1986, the average temperature departure of WenZhou increases obviously, among fourteen years, the average temperature has raised about 0.34°C.The average temperature of winter was 11.2°C in 1998, this winter was a warmer winter.

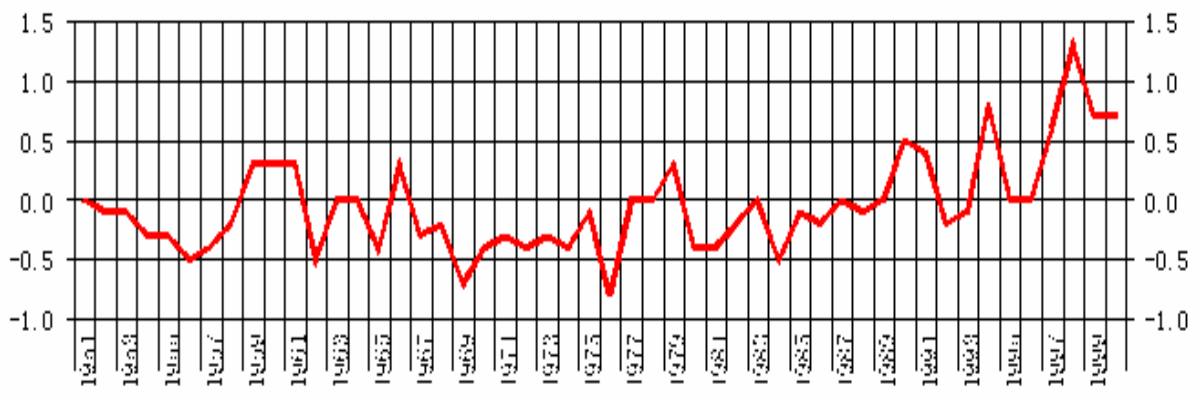

Figure 1 the average temperature departure from 1951 to 2000. (WenZhou station)

2. The changes of precipitation

In WenZhou, the precipitation changed very little in June from 1951 to 1986. After 1986, the precipitation departure of June is almost positive. It is 219.1mm in June, 2000. From 1989 to 2000, the years of the positive precipitation departure were nine, the percentage was 75%. The average temperature change affected the average precipitation of June. We may suggest that tropical systems come alive, resulted in the equatorial convergence belt and the secondary tropical anticyclone is extended northerly gradually as the global average surface temperature has increased.

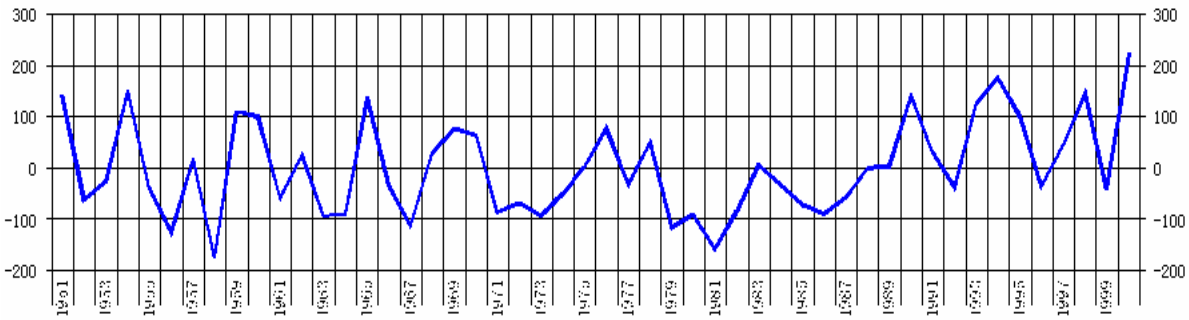

Figure 2 the average precipitation departure of June, from 1951 to 2000 (WenZhou station)

3. The changes of landing typhoon

From 1949 to 2002, there are all 425 landing typhoon in China, there are 8 landing typhoon every year. There are many differences of landing typhoon in coastal region. Recently we fined out the quantity of landing typhoon in high latitude increases obviously(table 1). From 1949 to 1980, there was twelve landing typhoons in ZheJiang, and fifty landing typhoons in FuJian, the percentage is 12/50=24%.But From 1981 to 2002, there was sixteen landing typhoons in ZheJiang, and thirty-one landing typhoons in FuJian, the percentage is 16/31=52%. The percentage is high obviously.

Table 1 landing typhoon comparison

Year	Fujian	Zhejiang	Percentage
1949～1980	50	12	24%
1981～2002	31	16	52%

4. Adaptation

4.1 Create and improve the warning system of meteorological disaster;

4.2 Improve hard the ecological environment;

4.3 Upgrade entirely the accuracy of weather forecast;

4.4 Improve the protective structures of hydrology;

4.5 Improve the awareness of everyone to prevent from and reduce meteorological disaster;

4.6 Create the system of preventing from and reducing meteorological disaster.

5. Conclusion

5.1 the temperature departure rises and precipitation departure of June increases of WenZhou obviously in lately fourteen years.

5.2 the percentage of landing typhoon rises clearly in lately twenty years.

5.3 we guess that the region affected by the equatorial convergence belt and the secondary tropical anticyclone is extended northerly gradually.

5.4 We discuss the adaptations to prepare for change.

ANALYSIS OF TYPHOON 0407 (MINDULE)

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Abstract

The direction and movement of T0407 (Mindule) is intricate. It swerved from west-northwestward to northward almost at a right angle on June 30th. T0407 hit Hualian County in Taiwan and Yueqing County in Zhejiang Province successively. Widespread inland gale was engendered during T0407 moving towards the sea east to Zhoushan. For a good understanding of the Typhoon track, process precipitation, and associated inland gale, we use MM5 model to simulate T0407. Synthetically, we analyze the MM5 results, infrared cloud pictures provided by Fengyun-2 Satellite, Image data from Doppler weather radar in Wenzhou City and Zhoushan City, observations from automatic weather stations in Zhejiang Province. We find that the direction of T0407 swerving to the north abruptly is caused by the intensifying and extending northward of the subtropical high between two typhoons. The precipitation cloud masses of the central and disturbing tail part of typhoon slow motion northward from southeast sea to Taiwan incessantly caused a torrential rainstorm. This storm rainfall is infrequent in Taiwan history. It involved two precipitation processes. Both lasted for long time. Because the inland air masses were dry and in "anticyclonic" vorticity, the precipitation was less when T0407 hit Yueqing County in Zhejiang Province. The structure of the severe tropical storm is very asymmetrical. When the eddy of STS conflicted with the cold air from north, inland gale was engendered in large area along north part of Zhejiang Province, south part of Jiangsu Province to Yangtze River Entrance. The Maximum wind speed exceeded the central wind speed of STS by far.

Key Words: Typhoon, Precipitation, Track, Inland Gale, STS (Strong Tropical Storm)